

FINAL REPORT

Solar Powered Remediation and pH Control

ESTCP Project ER-201033

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David Lippincott, PG
CB&I Federal Services

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14. ABSTRACT The objective of this research effort was to demonstrate Proton Reduction Technology (PRT) as a sustainable approach for treating low pH aquifers that are contaminated with cVOCs. The field demonstration project used electrodes inserted into PVC wells in a cVOC contaminated, Low pH aquifer. A low voltage current was applied to the electrodes to generate elemental hydrogen to support biodegradation, and to consume dissolved hydrogen ions and produce hydroxide to increase aquifer pH. The PRT system was operated for a total of 507 days from start-up to shut-down. The contaminated aquifer was inoculated with SDC-9 bioaugmentation culture to ensure that the appropriate dechlorinating bacteria were present to support biodegradation. Electricity to operate the system was provided by solar panels and deep cycle 12 V batteries. Results of the demonstration showed that reductive dechlorination of cVOCs in a low pH aquifer can potentially be supported by PRT, but, under the conditions of the demonstration, TCE dechlorination was not complete. The lack of complete dechlorination was likely due to the borderline pH and reducing conditions achieved in the aquifer.					
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ACRONYMS AND ABBREVIATIONS

2D	Two dimensional
AC/DC	Alternating current/direct current
AFB	Air Force Base
AW	Anode Well
Ba	Barium
BaCl ₂	Barium chloride
BMW	Background Monitoring Well
°C	Degrees Celsius
Ca	Calcium
CaCO ₃	Calcium carbonate
CB&I	CB&I Federal Services
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	chloroform
CH ₄	Methane
<i>cis</i> -DCE	<i>cis</i> -1,2-Dichloroethene
Cl ⁻	Chloride
cm	Centimeter(s)
cm ³	Cubic centimeter(s)
CMT	Continuous multichannel tubing
CO ₂	Carbon dioxide
COC	Chain of custody
cVOCs	Chlorinated volatile organic compounds
CW	Cathode/injection well
DC	Direct current
1,1-DCE	1,1-Dichloroethene
DHC	<i>Dehalococcoides</i> sp.
DMW	Demonstration Monitoring Well
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved oxygen
DOD	United States Department of Defense
EPA	Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
EVO	Emulsified Vegetable Oil
EW	Extraction well
Fe	Iron
gpm	Gallons per minute

GWQS	Ground Water Quality Standards
H ⁺	Free protons
H ₂	Molecular hydrogen
HCl	Hydrochloric acid
HMX	Her Majesty's Explosive; Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPT	Hydraulic profile testing
hr	Hours
HSA	Hollow Stem Auger
ICP	Inductively coupled plasma
IDW	Investigation Derived Waste
IPR	Interim Progress Report
IW	Injection well
JB MDL	Joint Base McGuire-Dix-Lakehurst
L	Liter(s)
lb	Pound(s)
m	Meter
mA	Milliamp
meq	Milliequivalent of hydrogen per 100 grams
Mg	Magnesium
mg/hr	Milligrams per hour
mg/L	Milligrams per liter
Mg(OH) ₂	Brucite
MgSO ₄	Magnesium sulfate
MLS	Multi-level sampler
mL	Milliliters
mM	Millimolar
mmoles	Millimoles
Mn	Manganese
Mn(OH) ₂	Manganese (II) hydroxide
mV	Millivolts
N	Nitrogen or Normal
Na ₂ CO ₃	Sodium carbonate
NaHCO ₃	Sodium bicarbonate
NaOH	Sodium hydroxide
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
O ₂	Oxygen

OH ⁻	Hydroxide ion
O&M	Operation & Maintenance
PCE	Tetrachloroethene
pH	Activity of hydrogens
P&ID	Piping & Instrumentation Diagram
P&T	Pump & Treat
PID	Photo-ionization detector
PMW	Performance Monitoring Well
PO ₄ ³⁻	Phosphate
ppm	Parts per million
ppmv	Parts per million by volume
PQL	Practical Quantitation Level
PR	Proton Reduction
PRB	Permeable Reactive Barrier
PRT	Proton Reduction Technology
PVC	Polyvinyl chloride
QA	Quality Assurance
qPCR	Quantitative polymerase chain reaction
RDX	Royal Demolition Explosive; 1,3,5-Trinitroperhydro-1,3,5-triazine
SDC-9	Shaw Dechlorinating Consortium
SERDP	Strategic Environmental Research and Development Program
SM	Standard method
SO ₄ ²⁻	Sulfate
SU	Standard units
SVE	Soil Vapor Extraction
SVOC	Semi-volatile organic compound
TCE	Trichloroethene
TDS	Total dissolved solids
TNT	Trinitrotoluene
TOC	Total organic carbon
TSS	Total suspended solids
USEPA	United States Environmental Protection Agency
V	Volts
VC	Vinyl chloride
VFA	Volatile fatty acid
VOA	Volatile organic analysis
VOC	Volatile organic carbon
wt	Weight

XRD	X-ray diffraction
yr	Year
ZVI	Zero-valent iron

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EXECUTIVE SUMMARY

Chlorinated volatile organic compounds (cVOCs), such as trichloroethylene (TCE) and perchloroethylene (PCE) represent one of the largest remediation challenges and costs at Department of Defense (DoD) sites. Anaerobic bioremediation via organic carbon source addition (with or without bioaugmentation with dechlorinating bacteria) is a commonly used approach to remediate cVOCs *in situ*. One significant issue with this approach is that reductive dechlorination processes are typically inhibited at pH values $< \sim 5.5$. Aquifers with lower pH values are common, especially in the eastern United States. Raising the groundwater pH is often not feasible because of the large amount of buffer needed, the large size of many plumes, and the need for long-term treatment and repeated reinjections. For these sites, an inexpensive and long-term source of electron donor to support *in situ* bioremediation is desirable.

Biological reductive dechlorination of cVOCs relies on the activity of dechlorinating bacteria, including members of the genus *Dehalococcoides* (DHC), that use hydrogen (H_2) as an electron donor and the cVOC as an electron acceptor. H_2 can also support the production of acetate, which DHC can use as a carbon source, by homoacetogenic bacteria. Proton Reduction Technology (PRT) generates H_2 by electrolysis, with concurrent reduction of protons (H^+) on the surface of cathodes powered by an impressed current. In addition to producing H_2 , PRT consumes protons, thereby raising the pH of groundwater around and downgradient of the cathode. Thus, during this project, PRT technology was evaluated for its ability to foster dechlorination through *in situ* H_2 generation while also raising the groundwater pH to favorable levels. In addition, we evaluated whether the technology was suitable for low cost prolonged treatment of sites where a persistent source of contaminant promises to create a long-term remediation problem (e.g., DNAPL sources or low permeability consolidated sediments), and for treating remote contaminant plumes where electrical power is not readily available or where long treatment times are expected. In addition, PRT can also support biological remediation of several other common DoD contaminants, including RDX, Cr(VI), and perchlorate.

The primary goal of this project was to demonstrate a solar-powered technology to generate hydrogen *in situ* and reduce aquifer acidity to promote reductive dechlorination. During operation, Proton Reduction Technology (PRT) uses a low voltage potential applied across electrodes installed within an aquifer to impress a direct current in the subsurface. PRT was tested in a low pH cVOC-contaminated aquifer at Joint Base McGuire-Dix-Lakehurst, NJ (JB MDL). A successful demonstration was expected to result in sustainable aquifer pH control and contaminant degradation at significantly lower cost than conventional approaches requiring additions of buffers and organic electron donors. Successful application of this technology would allow the DOD to economically treat contaminated low pH aquifers and remote contaminant plumes where electrical power is not readily available or where long treatment times are expected.

Detailed site characterization data were used to create a conceptual site model and to construct a numerical three dimensional groundwater model. Groundwater velocities were determined to be too slow (approximately 2-6 ft per month in the highest permeability layer) to allow for effective short-term monitoring during the course of the demonstration. Therefore, a groundwater recirculation system was installed and operated to force the groundwater gradient through the test plot and control plot, thereby speeding up groundwater velocities and allowing for more effective performance monitoring.

This field demonstration project used electrodes inserted into PVC wells within the cVOC-contaminated low pH aquifer. The electrodes (3 cathodes and 2 anodes) were operated to generate H₂ to support biodegradation, and consume H⁺ to increase aquifer pH. The PRT system was operated for a total of 507 days from start-up to shut-down. The demonstration was divided into four distinct phases of operation, which included PRT only operation, and PRT operation with varying groundwater recirculation configurations. The contaminated aquifer was inoculated with a bioaugmentation culture (SDC-9) to ensure that the appropriate dechlorinating bacteria were present to support biodegradation. Electricity to operate the system was provided by solar panels and deep cycle 12 V batteries. During the demonstration, we monitored groundwater pH, contaminant concentrations, H₂ production, distribution and utilization, and electrode performance.

Performance objectives were established for this demonstration to provide a basis for evaluating the use of solar-powered PRT to increase the pH of a naturally-acidic, TCE-contaminated aquifer at JB MDL, and to use the H₂ produced by proton reduction to support TCE dechlorination by dechlorinating bacteria. Performance criteria were selected based on factors that would likely be considered when bringing the proposed technology to full-scale application. These criteria included; increasing and maintaining a neutral aquifer pH, production and distribution of H₂, reduction of cVOCs, and PRT system reliability and ease of operation.

Although a significant pH increase (to pH 11.5 SU) was achieved in the cathode wells during Phases 1 and 2 of the demonstration, the pH impact was not observed in any of the downgradient monitoring wells, including multi-level sampling (MLS) well PMW-4, located only 2.5 ft down gradient of cathode CW-2. While increases in groundwater pH to above 6 SU were observed at some of the MLS well intervals during Phase 4 of the demonstration, the PRT system (as configured) was unable to maintain a consistent pH between 6.0 and 8.0 SUs within the designed treatment area.

Hydrogen in the cathode well groundwater remained saturated during Phase 1 and Phase 2 of the demonstration, reaching concentrations up to ~ 1,200 µg/L. During Phase 3 and Phase 4 of the demonstration, H₂ concentrations in the cathode well(s) decreased because the addition of extracted water to the cathode well (i.e., injection well) continually diluted H₂ concentrations and forced the H₂-containing groundwater into the aquifer. H₂ concentrations occasionally exceeded the target concentration of 0.010 µg/L at the MLS wells closest to the cathode wells. However, H₂ concentrations were more typically below the detection level (<0.008 µg/L) at these wells. Furthermore, dissolved H₂ concentrations at the MLS wells PMW-7 and PMW-8 monitored during Phase 4 of the demonstration were typically below 0.010 µg/L. Considering that the H₂ concentration at well CW-2 (cathode/injection well) was often >50 µg/L during this Phase, this suggests that there was a substantial sink for H₂ between CW-2 (cathode/injection well) and the MLS wells (located 2.5 ft and 5.0 ft away, and within the recirculation loop). Possible sinks for hydrogen include Fe and Mn reduction, sulfate reduction, acetogenesis, and methanogenesis, as well as dechlorination of TCE.

The concentration of TCE decreased notably in 5 of the 6 treatment zone monitoring MLS wells during Phase 4 of the demonstration, with decreases ranging from 31 percent to 89 percent. Additionally, notable transient increases in cDCE concentrations (up to an order of magnitude) were observed in the treatment zone monitoring wells during the last ~100 days of the demonstration. These data suggest that partial dechlorination of TCE was occurring within the treatment zone.

However, the lack of observed vinyl chloride and/or ethene concentrations at these wells indicated that complete reductive dechlorination was not occurring at a significant rate. This is likely due (at least partially) to the fact that optimal pH and ORP levels were not achieved within the treatment zone.

The PRT system was completely powered via an off-the-grid solar power system. The system consisted of four 85 watt photovoltaic solar panels, and four deep discharge 80 amp hour 12V batteries to provide consistent 24-hour operation of the PRT system. Field observations and system operating records indicated that the solar powered PRT system operated >95% of the time over a 2 year period, with minimal O&M required.

The expected cost drivers for installation and operation of a PRT system, and those that will determine the cost/selection of this technology over other options include the following:

- Depth of the plume below ground surface;
- Width, length, and thickness of the plume;
- Aquifer lithology and hydrogeology;
- Regulatory considerations concerning secondary groundwater impacts (i.e. metals mobilization, sulfate reduction, etc.);
- Length of time for clean-up (e.g., necessity for accelerated clean-up);
- The presence of indigenous bacteria capable of degrading chlorinated VOCs;
- Concentrations of contaminants and alternate electron acceptors (e.g., NO_3^- , SO_4^{2-} and O_2); and
- Presence of co-contaminants.

Based on a cost analysis for treatment of a shall groundwater plume (~10-50 ft bgs) of ~400 ft in width, a PRT barrier was determined to be the most cost effective option to treat a low pH, cVOC plume, compared to current alternatives. These alternatives included pump-and-treat, installation of a zero-valent iron permeable reactive barrier, and air-sparge with soil vapor extraction. Under this scenario, and assuming a 30 year operation period with equivalent cost for groundwater monitoring, the PRT barrier approach was estimated to be 20% to 60% less expensive than the other 3 alternatives. The PRT barrier alternative had both the lowest capital and O&M cost of the 4 alternatives that were evaluated.

PRT resulted in partial reductive dechlorination of cVOCs in the low pH aquifer at JB MDL, but TCE dechlorination was not complete, at least not under the conditions of the demonstration. The lack of complete dechlorination, even after bioaugmentation, was likely due to the borderline pH and reducing conditions achieved in the aquifer. It is possible that dechlorination activity could have been improved if a higher pH (e.g., pH 6.5 to 7) and/or more reducing conditions (e.g., ORP < -100 mV) were consistently achieved.

PRT was only partially successful in this test, but the results suggest it may be a useful component of an overall treatment system for remediating an acidic aquifer. However, additional treatments/amendments may be needed to better address and overcome the significant soil buffering capacity of many aquifers. For example, a large dose of buffer and a carbon substrate could be applied to a biobarrier at the start of treatment, to overcome the initial acidity of the aquifer sediments and to produce a low ORP before applying current, and PRT could then be used as a long term source of electron donor (H_2) and OH^- to maintain aquifer pH.

Although this study showed that PRT can have significant limitations, it also has provided valuable guidance for the ongoing development of the technology. One recently-demonstrated strategy to overcome the limitations observed in this project is to use more closely-spaced electrodes, and to install the electrodes with metallurgical soil contact material (Coke Breeze) as backfill. This approach was tested successfully in the field under the U.S. Navy's Environmental Sustainability Development to Integration (NESDI) program, during NESDI Project 501. This demonstration was conducted within a low pH cVOC-contaminated aquifer at Marine Corps Base Quantico, in Quantico, Virginia. During this 1-year field demonstration, eight closely-spaced cathodes and two downgradient anodes were installed in a barrier configuration, and concentrations of *cis*-DCE (the primary contaminant of concern) were reduced by 88 to 99 percent across the barrier.

1.0 INTRODUCTION

1.1 BACKGROUND

Chlorinated volatile organic compounds (cVOCs), such as trichloroethylene (TCE) and perchloroethylene (PCE) represent one of the largest remediation challenges and costs at Department of Defense (DoD) sites. Anaerobic bioremediation via carbon source addition (with or without bioaugmentation with dechlorinating bacteria) is a commonly used approach to remediate cVOCs *in situ*. One significant issue with this approach is that reductive dechlorination processes are typically inhibited at pH values $< \sim 5.5$ (e.g., Vainberg et al., 2009).

Low pH aquifers are common throughout the coastal plain aquifer of the eastern United States. For example, low pH groundwater is known to have affected bioremediation efforts at Joint Base McGuire-Dix-Lakehurst (JB MDL), NJ, Raritan Arsenal, NJ, Moody AFB, GA, Hunter Army Airfield, GA, Indian Head Naval Surface Warfare Center, MD, Marine Corp Base Quantico and Ft. Stewart, GA, among other facilities. Aquifer buffering has been attempted in some instances (e.g., Hatzinger et al., 2006; Schaefer et al., 2010), but the amount of buffer required makes this process cost prohibitive for other than very small sites.

As depicted in **Figure 1.1**, biological reductive dechlorination of chlorinated solvent contaminants relies on the activity of dechlorinating bacteria, including members of the genus *Dehalococcoides* (DHC), that use hydrogen (H_2) as an electron donor (He et al., 2002) and the cVOC as an electron acceptor. H_2 can also support the production of acetate by homoacetogenic bacteria, which DHC can use as a carbon source. During typical *in situ* remediation treatments, a carbon source such as vegetable oil, fatty acids, carbohydrates, etc., are added to the subsurface, and they are subsequently fermented by other members of the microbial community to produce the H_2 and acetate necessary for growth and activity of the dechlorinating bacteria.

Proton Reduction Technology (PRT) (**Figure 1.2**) generates H_2 by electrolysis, with concurrent reduction of protons (H^+) on the surface of cathodes powered by an impressed current. In addition to producing H_2 , PRT consumes protons, thereby raising the pH of groundwater around and downgradient of the cathode. Thus, during this project, PRT technology was evaluated for its ability to foster dechlorination through *in situ* H_2 generation while also raising the groundwater pH to favorable levels. In addition, we evaluated whether the technology was suitable for low cost prolonged treatment of sites where a persistent source of contaminant promises to create a long-term remediation problem (e.g., DNAPL sources or low permeability consolidated sediments), and for treating remote contaminant plumes where electrical power is not readily available.

1.2 OBJECTIVE OF THE DEMONSTRATION

The objective of this project was to demonstrate PRT as a sustainable approach for treating low pH aquifers that are contaminated with cVOCs. The approach may also be suitable for treating a range of other contaminants of concern to the DOD, such as perchlorate and Cr(VI) among others. As described in the introduction, the PRT demonstrated during this project utilized solar powered electrodes inserted into the subsurface to increase groundwater pH and produce H_2 that can be used as an electron donor by DHC and other dechlorinating bacteria (**Figure 1.1**).

The reduction of hydrogen ions occurs at low voltage (<2 V) and current (tens to hundreds of milliamps) which can economically be supplied by using a solar system, thereby allowing the technology to be applied in remote areas or to be operated for extended periods at low cost and low environmental impact. At higher voltages and current the system can split water (i.e., electrolysis) to produce OH⁻ ions and H₂ and consume great amounts of acid to allow neutralization of aquifers.

The primary goal of this project was to demonstrate application of PRT to treat a low pH cVOC-contaminated aquifer at JB MDL. A successful demonstration was expected to result in sustainable aquifer neutralization and contaminant degradation at treatment costs that are significantly lower than approaches that require addition of buffers and carbon-based electron donor. Successful application of this technology would allow the DOD to economically treat contaminated low pH aquifers and remote contaminant plumes where an electrical source is not readily available or where long treatment times are expected.

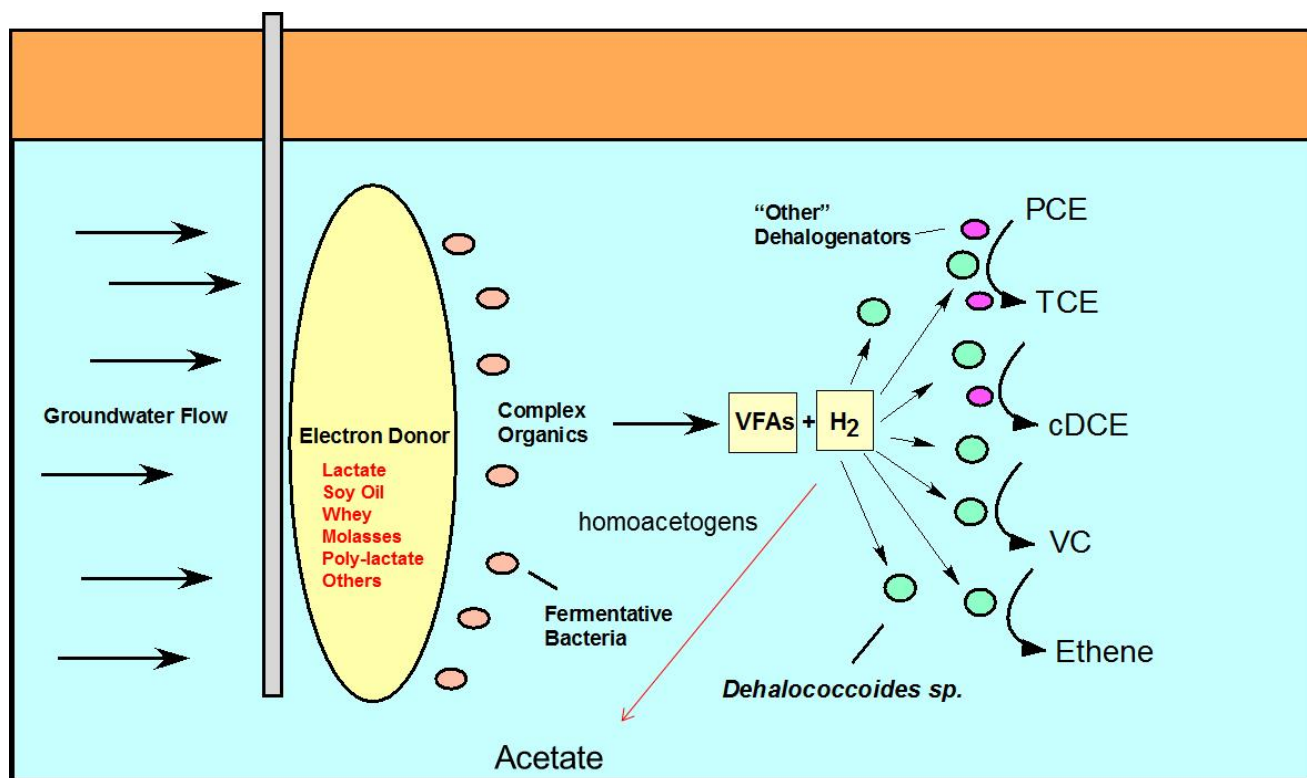


Figure 1.1. Schematic Representation of Traditional in situ Bioremediation Technologies

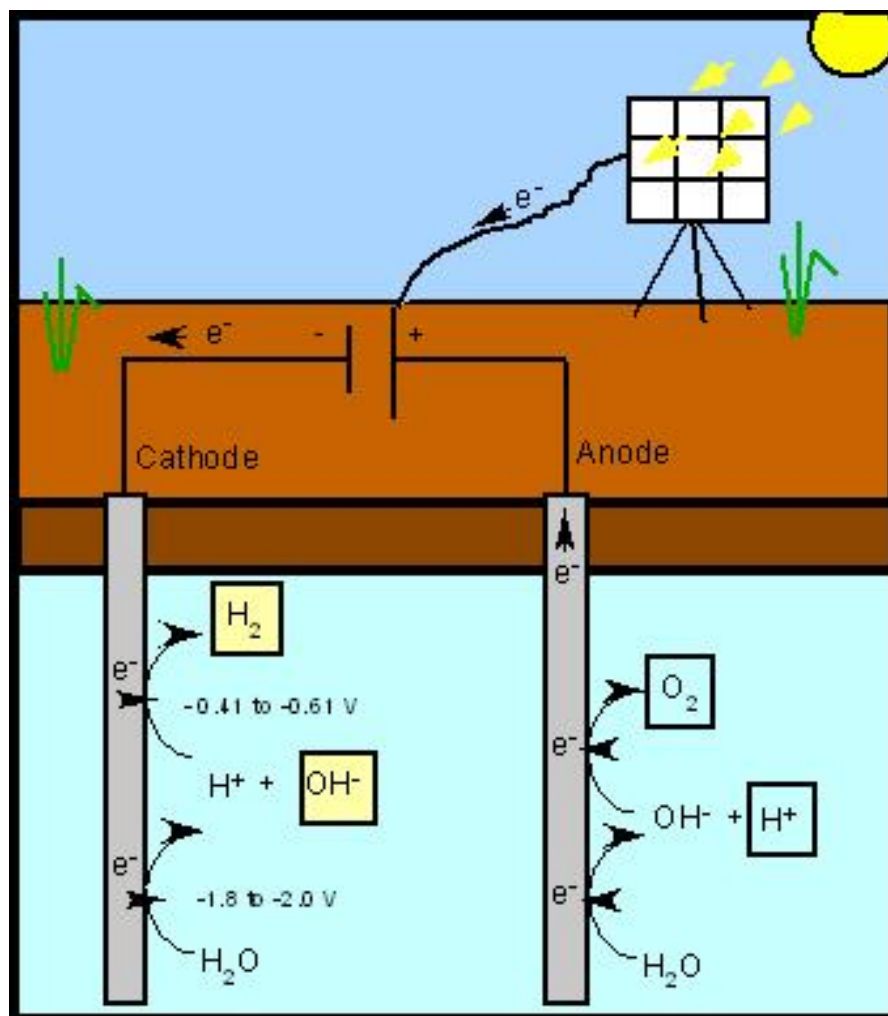


Figure 1.2. Schematic Representation of the Proton Reduction Technology (PRT)

1.3 REGULATORY DRIVERS

The JB MDL environmental restoration project, which includes the groundwater beneath the selected demonstration area, is operated under the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). JB MDL is under the jurisdiction of the United States Air Force (USAF) and the United States Environmental Protection Agency (USEPA) is the lead regulatory agency for JB MDL restoration activities, with some review by the New Jersey Department of Environmental Protection (NJDEP). In the State of New Jersey, groundwater cleanup standards protective of groundwater classifications are based on the primary receptors within that class as established pursuant to the New Jersey Ground Water Quality Standards (GWQS) (N.J.A.C. 7:9-6). As such, NJDEP has established natural groundwater quality as the cleanup standard for all contaminants in Class IA and I-Pinelands (Preservation Area) groundwater, which includes the groundwater at JB MDL. The numerical criterion for any organic contaminant discovered at a contaminated site that is not the result of natural processes is zero.

Since zero can only be measured with a certain degree of certainty, the Practical Quantitation Levels (PQLs) for groundwater have been selected for use in determining whether organic contaminant concentrations observed in groundwater meet the groundwater standard/criteria. The main contaminants of concern in the JB MDL groundwater plume are TCE and *cis*-1,2-dichloroethylene (*cis*-DCE). Based upon the New Jersey criteria, the groundwater standard for TCE is 1 microgram per liter ($\mu\text{g/L}$) and the standard for *cis*-DCE is 2 $\mu\text{g/L}$. Based on USEPA National Primary Drinking Water Regulations (USEPA, 2009), the Maximum Contaminant Level in groundwater for TCE and *cis*-DCE are 5 $\mu\text{g/L}$ and 70 $\mu\text{g/L}$, respectively.

2.0 TECHNOLOGY

2.1 TECHNOLOGY DESCRIPTION

CVOCs have been widely used for an array of industrial applications, including as solvents for cleaning aircraft, machinery, and parts. Improper use, handling, and disposal of these compounds have ultimately led to them becoming common groundwater contaminants in the United States and elsewhere. Remediation techniques for groundwater contaminated with these compounds have evolved over the last twenty years from traditional pump and treat technologies, air sparging, and soil vapor extraction, to the wide-spread use of bioremediation technologies. In many cases, bioremediation can be facilitated by naturally-occurring consortia of microorganisms, but in some such cases, remediation practitioners have resorted to adding exogenous bacterial cultures that have been selected and cultured for their ability to completely degrade the chlorinated pollutants to support *in situ* bioremediation. This process of bioaugmentation has proven successful in numerous field applications (Harkness et al., 1999; Lendvay, et al., 2003; Major et al., 2002; Steffan et al., 1999) and its use as a remedial approach has increased greatly over the past several years.

Most successful bioremediation applications have been performed in aquifers with circum-neutral pH, or, less frequently, where pH has been adjusted by adding a buffering agent. Bioremediation in low pH aquifers, however, is usually ineffective, presumably because dehalogenating organisms do not dechlorinate well below pH~5.5 (**Figure 2.1**; McCarty et al., 2007; Sung et al., 2003; Vainberg et al., 2009; Zhuang and Pavlostathis; 1995). In many cases, low pH is a function of the natural site geochemistry, but low pH conditions also can occur as a result of substrate fermentation and reductive dechlorination of target cVOCs (Adamson et al., 2004; Amos et al., 2008; Chu et al., 2004; Lee et al. 1998). In fact, many low pH aquifers appear to exhibit classic *cis*-DCE or VC stalls, leading to the accumulation of these daughter products that are more toxic than the parent PCE or TCE. **Figure 2.2** shows the results of a treatability test performed with samples from a low pH aquifer in the eastern US. Biostimulation with lactate or lactate with pH adjustment did not support complete dehalogenation of TCE. Likewise, bioaugmentation without pH adjustment resulted in incomplete destruction of the target contaminants. Only pH adjustment with bioaugmentation resulted in complete dehalogenation of the target contaminants.

Aquifer buffering, while effective at small scale, is typically impractical for full-scale remedial efforts due to the quantity of buffer required to overcome the aquifer acidity and the necessity to distribute this buffer throughout the aquifer. For example, during an *in situ* demonstration conducted in Indian Head, MD, nearly 4500 L of a 6.7 % solution of carbonate buffer solution was required to increase the pH of groundwater in a small pilot site (3.7 m sq. area x 3 m of groundwater depth deep) from an average of ~ 4.7 to ~ 6.3 SU (Hatzinger et al., 2006). This equates to 357,000 gal of a similar concentrated buffer for a 1 acre remedial site with only 3 m of saturated zone. During a bioaugmentation demonstration at Fort Dix, NJ (ESTCP project ER-0515) 6800 lb of sodium bicarbonate and 9600 lb of sodium carbonate were needed to sustain a suitable pH in a 40' x 40' x 10' thick pilot test plot in a naturally-low pH aquifer. Clearly, standard buffering approaches can be both expensive and impractical for a large-scale remediation.

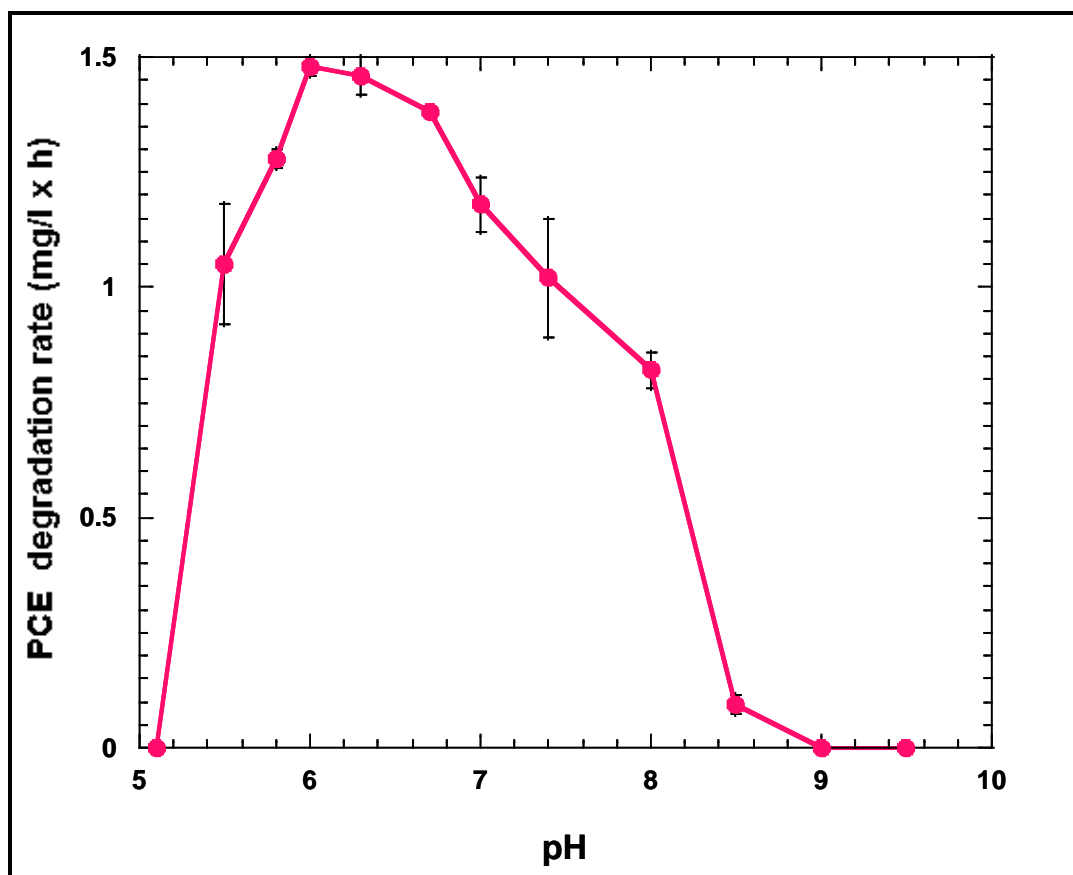


Figure 2.1. Effect of pH on PCE Dehalogenation by the DHC-Containing Culture SDC-9

(from Vainberg et al., 2009)

The reason that low pH inhibits dechlorination by DHC is unknown, but the effect of low pH on other bacteria has been extensively studied (Lowe et al., 1993; Olson, 1983). Furthermore, some low pH aquifers have resident DHC populations, but these organisms generally appear unable to dechlorinate TCE or PCE past *cis*-DCE. For example, molecular analyses performed in groundwater at JB MDL, NJ, which has a pH of ~ 4, demonstrated that DHC were present in the aquifer (Steffan et al., 2010). Nonetheless, the aquifer exhibited a *cis*-DCE stall. Studies in our laboratory (**Figure. 2.1**; Vainberg et al., 2009) demonstrated that DHC in our SDC-9 culture do not dehalogenate PCE well at pH <5.5, although the culture is viable at this pH. It is anticipated that most low pH cVOC contaminated aquifers will require both pH adjustment and bioaugmentation to facilitate complete reductive dechlorination.

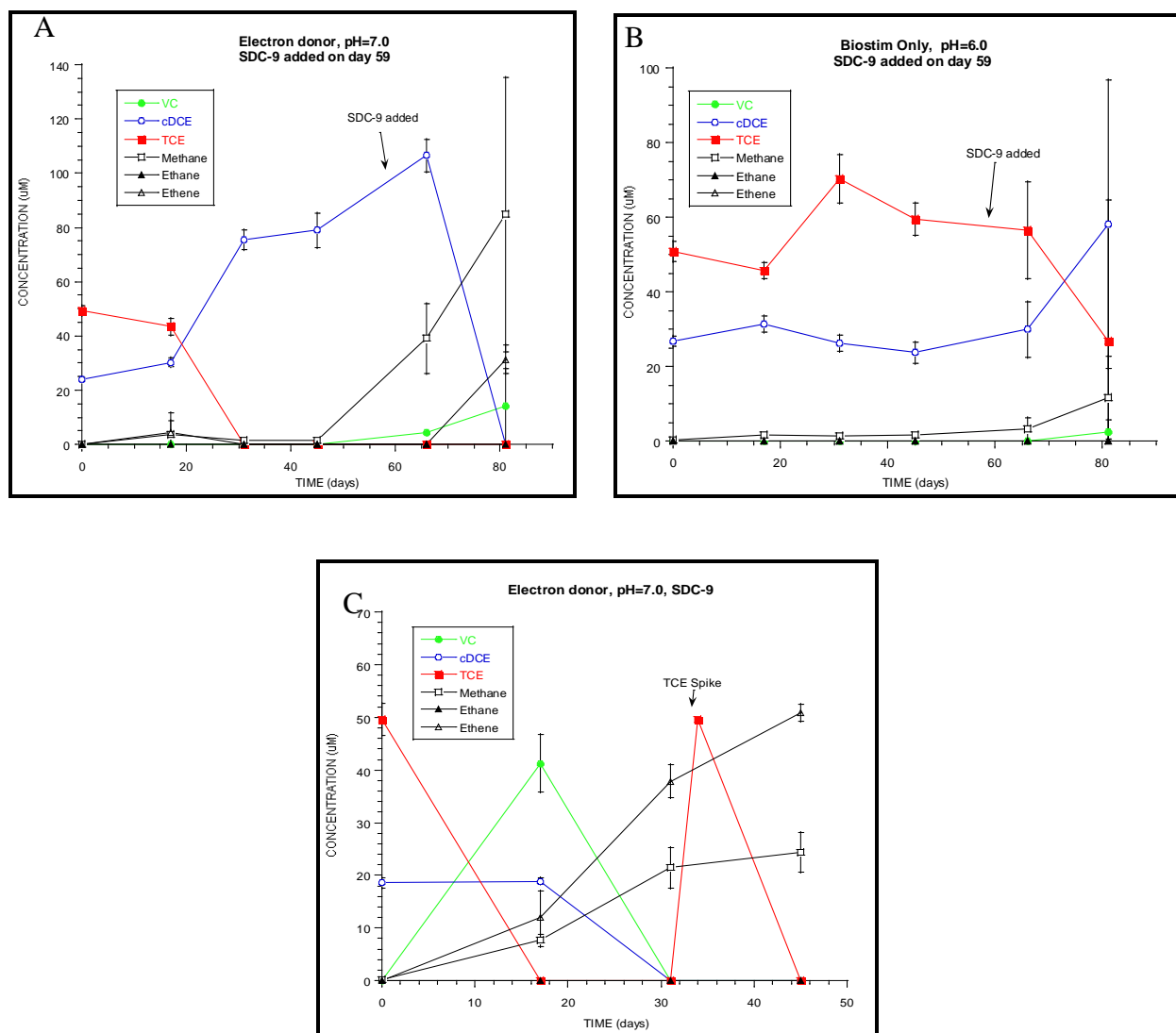


Figure 2.2. Data from Microcosm Study with Low pH Aquifer Samples

TCE and cis-DCE were not degraded at pH 6 until after SDC-9 was added (A). pH adjustment alone did not allow complete dehalogenation (B), but a combination of pH adjustment and bioaugmentation allowed rapid and complete dehalogenation of TCE (C).

2.1.1 Role of H₂

Molecular hydrogen (H₂) is an important energy source and electron donor in anaerobic metabolism, including dehalorespiration (Holliger et al., 1999; Maymó-Gatell et al., 1995). This knowledge has resulted in the development of remediation strategies that attempt to stimulate dehalogenation *in situ* by applying carbon sources that can be fermented to H₂. Application of carbon to large or low permeability aquifers can be costly or result in poor electron donor distribution, respectively. Direct *in situ* H₂ generation by electrical reduction of free protons (H⁺) is a novel alternative to carbon source addition. Yang and McCarty (1998) and Ballapragada and colleagues (1997) have demonstrated that cVOC degrading bacteria have a high affinity for H₂, and that even H₂ concentrations as low as 2 nM (4 ng/L) can support reductive dechlorination.

The direct addition of H₂ has been used to support reductive dechlorination *in situ* (Fisher et al. 1997, Ma et al., 2003) and in bioreactors (Carr and Hughes, 1998; Chung et al., 2008). H₂ can support the biological reduction of other important contaminants including explosives (RDX, HMX, TNT; Adrian et al., 2003), perchlorate (Nerenberg et al., 2006; Hatzinger, 2005; Hatzinger et al., 2006), and Cr(VI) (Wang and Shen, 1995), so the technology is expected to be widely applicable.

Proton reduction refers to the production of elemental hydrogen (H₂) by direct electrical reduction of dissolved hydrogen ions (H⁺) in a soil/water solution (**Figure 1.2**) in the absence of oxygen. This process has been exploited recently for efficient H₂ production in microbial fuel cells, without electrolysis of water (Call and Logan, 2008; Cheng and Logan, 2007). Proton reduction occurs at a potential of ~ -0.5 V which can be supplied easily with solar powered batteries. In addition, the polarity of the proton reduction system can be periodically alternated (i.e., the anode becomes a cathode) to increase the size of the treatment area, to control the production of H₂ to minimize methane production, and to control changes in pH that can occur if necessary. The technology was recently demonstrated in laboratory studies for supporting the biodegradation of cVOCs (Lohner and Tiehm, 2009; Lohner et al., 2011).

2.1.2 Electrochemical Reactions in Soil

Rahner et al. (2002) demonstrated that applying a low direct current to soils resulted in the production of “microcapacitors” that acted as diluted electric chemical solid bed reactors. The theory states that electrochemical reactions can be induced in wet soils if the soil matrix contains particles or films with electronic conducting properties (Rahner et al., 2002). In effect, soil particles can act as capacitors that store enough energy, even if charged with a low energy current, to perform high energy chemical reactions. These microcapacitors could reduce mobile oxidized chemicals in water, and reactive materials in soils that could potentially support this activity included graphite and some iron minerals. In follow-on studies by the same group (Röhrs et al., 2002), they showed that electrical current could be used to reduce chlorinated hydrocarbons in soils from an industrial site, and they concluded that these “microconductors” in the soil probably play a role in the reactions. In a more recent study, electrical current was used to reduce cVOCs in clay soils at low electrical potential (Jin and Fallgren, 2010). These researchers described the process as involving the formation of “microcapacitors” (**Figure 2.3**), whereby hydrated clay particles become redox reactive particles and form a reactive matrix on which these redox reactions (e.g., electrolysis) can occur. They postulated that an induced electrical field in soils is created with the soil particles acting as capacitors that discharge and recharge electricity that can perform electrolysis of water, thereby generating H₂. In addition, they reported up to 90% reduction in TCE concentrations in the clays over 7 days under an applied current of only 6 V/m, and suggested that the decrease was due to electrically induced reduction, and not due to electrokinetic ion migration or electrophoresis. Decreases in TCE correlated with an increase in chloride concentration, and no biological daughter products were reported. The application of this process to generate H₂ in low permeability soils to enhance biodegradation of cVOCs was evaluated in the field during this project.

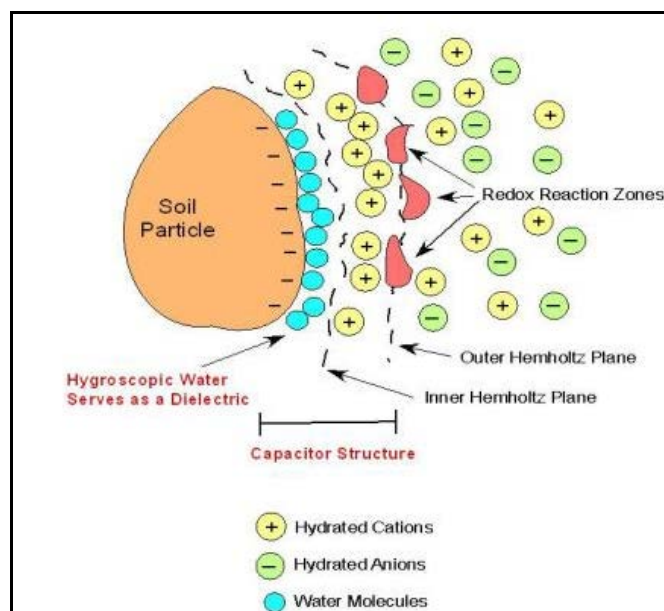


Figure 2.3. Proposed Microcapacitor Structure Generated in Clay Soils Exposed to an Electrical Field.

Electrically induced reduction of TCE (and presumably H^+) is believed to occur as the capacitor charges and discharges electricity (derived from Jin and Fallgren, 2010).

2.1.3 Hydrolysis-driven pH adjustment

In addition to H_2 production, electrical current can be used to increase aquifer pH. At an electrical potential of ~ -2 V, water molecules are split into hydrogen ions (H^+ ; proton) and hydroxide ions (OH^-). This process is commonly referred to as electrolysis or hydrolysis. The produced protons will then be reduced to H_2 , thereby increasing aquifer pH. In theory, any amount of H^+ can be consumed using this process; allowing neutralization of even very low alkalinity groundwater, like that present at JB MDL. Again, the relatively low electrical potential required for this process can be generated by a solar/battery direct current system. Because of the relatively slow movement of groundwater at many sites, operation of this process using solar panels without batteries (which would provide continuous operation) would allow for operation during daylight hours, and still have the potential to control pH and drive reductive dechlorination. CVOCs and energetic materials also can be directly reduced on the cathode surface via electrolytic reduction as demonstrated during ESTCP project ER-0519 (Sale et al., 2010). The greatest limitation to both hydrolysis and direct reduction of contaminants on electrodes is that the reductive processes occur primarily (if not solely) on the electrode (i.e., cathode) surfaces, so contact between water/protons (PRT) or the contaminants and the electrodes is required. In the case of direct contaminant reduction, large cathode surface areas are required for effective *in situ* treatment. However, natural groundwater flow can be used to distribute the hydroxide ions via diffusion and convection, and provide a mechanism for increasing pH downgradient of the cathode(s), thus effectively neutralizing a portion of the aquifer (i.e. treatment zone).

2.2 TECHNOLOGY DEVELOPMENT

CB&I has used proton reduction for H₂-driven bioremediation of cVOCs at multiple sites, but the overall success of the approach was always difficult to determine because either other technologies were also applied (e.g., carbon source addition plus PRT) or because only limited sampling was performed (**Table 2.1; Figure 2.4**). At one site, three electrodes were successfully operated by using two 12V automotive batteries with an inexpensive solar charger. At another site in the Southwest, a 750 ft permeable reactive barrier was created by using electrodes to prevent off-site migration of mixed cVOCs including chloroform. The system operated successfully for more than 1 year with the original electrodes. Electrode (0.1" x 30' NiTi) costs for this system were only \$130 each. To further prolong electrode life, electrodes in the system were ultimately replaced with the mixed metal oxide-coated titanium mesh electrodes evaluated during this project. Another application performed by CB&I utilized a circular array of electrodes to remediate a dry cleaner site. The polarity of the electrodes could be reversed to generate H₂ throughout the treatment zone. During operation of these other systems high pH values (to pH 12) were periodically measured in cathode wells during system operation optimization, leading to the hypothesis that this process could also be used to neutralize acidic groundwater. In addition, Gent et al. (2009) demonstrated that electrical current could be used to increase the pH of groundwater to a level sufficient to hydrolyze RDX. Those experiments, however, were performed at much higher voltages (to 600V) than those used during this PRT demonstration.

Table 2.1. CB&I Field-Scale Applications of Proton Reduction Technology

Site	Contaminant	Facility Type	State	Outcome
Westinghouse	PCE/TCE	Transformer Maintenance Facility	WI	Solar powered; risk based closure after 4 yrs of operation
Mirro	PCE/TCE	Aluminum Manufacturer	WI	Operated 4 yrs; site closure achieved
Tronox	Chloroform/PCE	Chemical Manufacturer	OK	Ongoing >9 yr; ~700-ft PRB preventing off site contaminant migration
Tronox	Chloroform/PCE	Chemical Manufacturer	OK	Ongoing >9yr, 80-ft source zone barrier, significant CF reductions
Carroll College	PCE/TCE	Industrial Dry Cleaner	WI	Operated 4 yrs, site closure approved



Figure 2.4. Field-Scale PR Pilot System at a Tronox Site in Oklahoma.

The permeable reactive barrier created by PRT extends ~600 ft. and is composed of 42 electrodes. It has been operated successfully for >10 years.

2.3 ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY

Treatment of low pH sites with buffers to increase groundwater pH is often not practical because of the large amount of buffer needed and the large size of many of the affected plumes. In other cases contaminants accumulate in low permeability matrices or as free product (e.g., DNAPL) and become long term sources of contamination that require prolonged and costly treatment. For these sites, an inexpensive and long-term source of electron donor and pH buffering to support *in situ* bioremediation is desirable. A potential advantage of PRT is that it would be suitable for use in most cVOC-contaminated aquifers, for treating low pH aquifers, and potentially for treating any contaminant that can be remediated by H₂-driven bioremediation (e.g., CVOCs, energetic compounds, and perchlorate). It also has the potential to be suitable for prolonged treatment at sites where a persistent source of contaminant will lead to long-term remediation challenges (e.g., DNAPL sources or consolidated sediments), and for treating remote sites where accessing or maintaining electrical feeds is cost prohibitive.

One potential limitation of this process is the production of H⁺ and O₂ at the system anode(s). O₂ will inhibit dechlorinating organisms, and the produced H⁺ can reduce aquifer pH. Also, previous studies that have attempted to use hydrogen injection technologies to stimulate *in situ* reductive dechlorination have demonstrated that competition for H₂ by methanogenic and other microorganisms can limit its availability for DHC and other dechlorinating bacteria in some

instances (Clapp et al., 2004; Ma et al., 2006). We anticipated that some of these limitations might be ameliorated by controlling the operation of the PRT system and by appropriate in-field configuration. First, the polarity of the electrodes can be periodically switched so that the electrodes are alternatively used as anodes or cathodes. Upon switching the anode to a cathode, any oxygen near the electrode will be reduced rapidly to water, and protons present will subsequently be reduced to H_2 . This approach has proven successful in other applications of this technology by CB&I. Another advantage of this approach is that periodic production of O_2 may actually inhibit methanogens that are very sensitive to oxygen and that compete for H_2 . Call and Logan (2008) demonstrated that periodic additions of air to a H_2 -generating microbial fuel cell improved H_2 yields by inhibiting methanogens. We have observed that dehalogenating bacteria are less sensitive to dissolved oxygen than often reported (unpublished data). Secondly, depending on the cathode configuration, the anodes can potentially be placed in a side-gradient position so that anode-produced O_2 and H^+ does not interfere with the treatment process. Testing by CB&I at one site has demonstrated that sufficient current can be maintained between electrodes spaced more than 250 ft apart. This spacing, however, will depend on aquifer geochemistry and electrical conductivity of subsurface materials.

Poor distribution of H_2 within the designed treatment zone could limit the remedial performance of the electrolysis system. As discussed in **Section 2.1.2**, the potential for generation of H_2 between inserted electrodes via the electrolysis of water on clay surfaces that are acting as microcapacitors was evaluated in the field during this project. These potential microcapacitor processes could have significant impacts on the required spacing between cathodes, and the effectiveness of hydrogen distribution. If these microcapacitor processes could be shown to occur at the field scale, then H_2 generation may not be limited to the inserted cathode surface, and its distribution in the subsurface could be greatly increased. Alternatively, H_2 generation solely at the inserted cathode surface would limit its distribution in the subsurface primarily to advection and dispersion mechanisms.

Finally, scale formation on or corrosion of inserted electrodes could limit the performance of the electrolysis system. Degradation of the electrode surface could reduce the amount of current generated at a given voltage, thereby reducing hydrogen and hydroxide generation at the cathodes, and the overall efficiency of the proton reduction system. As discussed in **Section 5.3.4**, several electrode materials were tested for effectiveness and longevity in the lab prior to design of the field demonstration.

3.0 PERFORMANCE OBJECTIVES

The performance objectives for this project are listed in **Table 3.1**. An *in situ* field demonstration was performed in an effort to attain these objectives using electrodes inserted into the aquifer for generation of H₂ at the cathode (**Figure 1.1**), and potentially on soil particles between the anode and cathode (**Figure 2.3**). The consumption of H⁺ during proton reduction was expected to increase the pH of the groundwater and the H₂ generated would be used as an electron donor to support *in situ* bioremediation. The main objective of the demonstration was to effect sustainable aquifer neutralization and contaminant degradation at treatment costs that are significantly lower than common treatment approaches that require addition of buffers and exogenous electron donor compounds.

Table 3.1. Performance Objectives Evaluated

TYPE OF OBJECTIVE	PRIMARY PERFORMANCE METRICS	EXPECTED PERFORMANCE METRICS	ACTUAL PERFORMANCE	WAS PERFORMANCE METRIC ACHIEVED?
Quantitative	Effectiveness	Increase and maintain pH to between 6 and 8 SUs within the designed treatment zone	pH was not successfully increased down-gradient of the cathodes, but after the creation of a second recirculation loop, some pH increases were observed approximately 5 ft. from the system cathode.	Partially
Quantitative	Effectiveness	Measured H ₂ concentrations >160 µg/L (10% solubility) at cathode wells	H ₂ consistently measured >160 µg/L during Phase 1 and 2 of the demo.	Yes
Quantitative	Effectiveness	Measurable H ₂ one meter down gradient of cathode.	Sporadic detections of hydrogen at monitoring wells.	Partial
Quantitative	Effectiveness	95% reduction of TCE and <i>cis</i> -DCE (2 µg/) in test plot	TCE and <i>cis</i> -DCE degradation was achieved, but we did not achieve 95% reduction, nor consistent treatment	No
Quantitative	Effectiveness	Complete and prolonged biodegradation of TCE and <i>cis</i> -DCE to ethene	Although some ethene was measured, we could not confirm sustainable VC degradation	No
Quantitative	Effectiveness	Distribution and growth of added DHC to >10 ⁷ DHC/L	No evidence of growth or distribution of DHC was demonstrated.	No
Quantitative	Effectiveness	Electrode stability (performance and physical) for >1 yr of field operation.	Electrodes performed for 2 years without measurable loss of performance	Yes
Qualitative	Implementable	Design and implementation of a field demo. system	System allowed flexible operation and sufficient monitoring	Yes
Qualitative	Implementable	Sustained solar-power output sufficient to promote pH increase and H ₂ production.	Sustained solar output for 2 years	Yes
Qualitative	Safety	No safety hazard/incidents	No safety incidents or hazardous conditions occurred.	Yes

3.1 INCREASE AND MAINTAIN NEUTRAL AQUIFER PH

In order for successful bioremediation to occur, the groundwater pH in the treatment zone must be increased to a pH of approximately 6 or greater. In this demonstration, the objective was to achieve this increase in pH via the use of electrodes inserted into the subsurface to consume H^+ and produce OH^- .

3.1.1 Data Requirements

The collection of numerous complete and reliable sets of groundwater pH data at different time points throughout the demonstration was required to evaluate this performance objective. Two baseline sampling events were performed in which groundwater samples were obtained and analyzed on site using a YSI field meter to determine the initial pH of the groundwater in the test plot and control plot prior to system start-up. Groundwater samples were collected and analyzed on site for pH forty times during the Period of Operation, which continued for 2 years, and the data collected was used to determine whether the groundwater pH in the test plot and control plot had increased above 6 SUs.

3.1.2 Success Criteria

Data collected during the Period of Operation was compared to the data collected during baseline sampling and system startup to determine the increase in pH during operation of the proton reduction system. For this performance objective to be considered successful, the pH of the groundwater in test plot monitoring wells immediately downgradient of the cathodes (i.e. treatment zone) needed to be increased and maintained to between 6 and 8 SUs. As detailed in **Section 5.7.2**, no significant increases in aquifer pH were observed at the monitoring wells located downgradient of the cathodes during Phase 1 through Phase 3 of the demonstration. Upon initiating operation of a small recirculation system on day 233 (Phase 4), groundwater pH at some of the multi-level sampling (MLS) well intervals (particularly PMW-7S) began to increase, and pH levels near pH 6 were achieved. Because pH is a log scale, the increase in pH at PMW-7S indicated an approximately 10-fold reduction in acidity at this location. However, consistent and significant pH increases throughout the designed treatment zone were not observed during Phase 4 of the demonstration. It is likely that the degree of electrolysis occurring at the cathode during Phase 4 was not sufficient to substantially increase the pH of acidic groundwater being continually re-circulated into the injection/cathode well, as the high pH levels observed in the electrode/cathode wells during Phase 1-3 of operation were not observed during Phase 4.

3.2 PRODUCTION OF H_2 AT THE CATHODE

The primary goal of this performance objective was to confirm that H_2 was being generated at the cathodes.

3.2.1 Data Requirements

The collection of numerous complete and reliable sets of groundwater dissolved H_2 data at different time points throughout the demonstration was required to evaluate this performance objective.

Two baseline sampling events were performed in which groundwater samples were obtained and analyzed to determine the initial dissolved H₂ concentrations of the groundwater in the demonstration plots prior to system start-up. Groundwater samples were collected and analyzed for dissolved H₂ 35 times during the Period of Operation, which continued for 2 years. H₂ data collected from wells within the test plot were compared to data collected from within the control plot, as well as data collected from a MLS background well. The data collected was used to determine the concentrations of H₂ being generated at the electrode/cathode wells.

3.2.2 Success Criteria

This performance objective was to be considered successful if groundwater dissolved H₂ concentrations of >130 µg/L (approximately 10 percent of solubility) were measured at each of the three cathode wells. Once operation of the proton reduction system was optimized, H₂ concentrations in the demonstration plot cathode wells consistently exceeded 160 µg/L and reached concentrations up to approximately 1,200 µg/L (>90 percent of solubility). H₂ concentrations in the cathode wells groundwater remained high during Phases 1 and 2 of the demonstration. During Phase 3 and 4 of the demonstration, H₂ concentrations in the cathode well(s) decreased because the addition of extracted water to the cathode wells (i.e., injection wells) continually diluted H₂ concentrations and forced the H₂-containing groundwater into the aquifer.

3.3 DISTRIBUTION OF H₂ TO 1 METER DOWNGRADIENT OF THE CATHODE

In order for H₂ to be effective as an electron donor to support biological reductive dechlorination, it must be adequately distributed throughout the treatment zone. The goal of this performance objective was to confirm that H₂ was present in adequate concentrations at least 1 meter downgradient of the cathodes where it was formed. The extent to which dissolved H₂ migrates downgradient of the cathode is largely dependent upon the groundwater velocity and the site-specific H₂ utilization rate. Additionally, we attempted to evaluate the potential for generation of H₂ between inserted electrodes via the electrolysis of water on clay surfaces that may act as microcapacitors (as discussed in **Section 2.1.2**).

3.3.1 Data Requirements

The collection of numerous complete and reliable sets of groundwater dissolved H₂ data at different time points throughout the demonstration was required to evaluate this performance objective. Two baseline sampling events were performed in which groundwater samples were obtained and analyzed to determine the initial dissolved H₂ concentrations of the groundwater in the test plots prior to system start-up. Groundwater samples were collected and analyzed for dissolved H₂ 35 times during the Period of Operation, which continued for 2 years. H₂ data collected from wells within the test plot were compared to data collected from within the control plot, as well as data collected from a MLS background well. The data collected were used to determine the concentrations of H₂ at the MLS monitoring wells installed between the electrodes and throughout the test plots, and to establish whether the H₂ concentrations were adequate for reductive dechlorination (>4 ng/L, as discussed in **Section 2.1.1**).

3.3.2 Success Criteria

This performance objective was to be considered successful if groundwater H₂ concentrations of >0.010 µg/L (2.5 times the concentration required to support reductive dechlorination) for were present at least 1 meter downgradient of the cathode wells. During the demonstration, H₂ concentrations occasionally exceeded 0.010 µg/L at the MLS wells closest to the cathode wells. However, H₂ concentrations were more typically below the detection level (<0.008 µg/L) at these wells. Furthermore, dissolved H₂ concentrations at the two MLS wells monitored during Phase 4 (operation of a small groundwater recirculation loop) of the demonstration were typically below 0.010 µg/L. Considering H₂ concentrations at well CW-2 (cathode/injection well) were typically >50 µg/L during this Phase, this suggests that there was a substantial sink for hydrogen between CW-2 (cathode/injection well) and the MLS wells (located 2.5 ft and 5.0 ft away, and within the recirculation loop). Possible sinks for hydrogen include iron and manganese reduction, sulfate reduction, acetogenesis, and methanogenesis, as well as dechlorination of TCE.

3.4 REDUCTION OF TCE AND *cis*-DCE IN THE TEST PLOT

The main contaminants of concern in the JB MDL groundwater plume at Area SS-36 are TCE and *cis*-DCE. The goal of this performance objective was to achieve >95% reduction in groundwater TCE and *cis*-DCE concentrations within the test plot.

3.4.1 Data Requirements

The collection of numerous complete and reliable sets of groundwater VOC data at different time points throughout the demonstration was required to evaluate this performance objective. Two baseline sampling events were performed in which groundwater samples were obtained and analyzed to determine the initial dissolved VOC concentrations in the groundwater in the test and control plots prior to system start-up. Groundwater samples were collected and analyzed for VOCs 14 times during the Period of Operation, which continued for 2 years. VOC data collected from wells within the test plot were compared to data collected from within the control plot, as well as data collected from a MLS background well. The data collected were used to determine the extent of TCE and *cis*-DCE reduction and daughter product formation in the test plot.

3.4.2 Success Criteria

This performance objective was to be considered successful if TCE and *cis*-DCE concentrations in the test plot monitoring wells were reduced by >95%. Measureable reductions in TCE concentrations, ranging between 31 and 89 percent, were observed at 5 of the 6 MLS well intervals monitored throughout the course of the demonstration. Biodegradation was apparent in the treatment zone following the first bioaugmentation as indicated by the transient increase of the dechlorination daughter product *cis*-DCE at some locations. However, we did not measure reductions in TCE and *cis*-DCE concentrations >95% at any of the monitoring wells during the demonstration.

3.5 COMPLETE AND PROLONGED BIODEGRADATION OF TCE TO ETHENE

The goal of this performance objective was to achieve sustainable TCE and *cis*-DCE biodegradation *in situ* for a minimum of eight months, and to demonstrate that these compounds were reduced completely to ethene.

3.5.1 Data Requirements

The collection of numerous complete and reliable sets of groundwater VOC and reduced gases data at different time points throughout the demonstration was required to evaluate this performance objective. Two baseline sampling events were performed in which groundwater samples were obtained and analyzed to determine the initial dissolved VOC and reduced gases concentrations in the groundwater in the test and control plots prior to system start-up. Groundwater samples were collected and analyzed for VOCs and reduced gases 14 times during the Period of Operation, which continued for 2 years. VOC and reduced gases data collected from wells within the test plot were compared to data collected from within the control plot, as well as data collected from a MLS background well. The data collected was used to establish the extent of TCE reduction and daughter product formation in the test plot.

3.5.2 Success Criteria

This performance objective was to be considered successful if reductive dechlorination of TCE and *cis*-DCE were prolonged throughout the Period of Operation, and if TCE degradation proceeded completely to ethene without stalling at *cis*-DCE or VC. It was expected that *cis*-DCE and VC would be produced as transient intermediates of TCE degradation and also would be rapidly degraded. While some substantial transient increases in *cis*-DCE were observed at some of the test plot MLS wells, only traces of vinyl chloride were observed. Furthermore, while some low levels of ethene were observed, the source of the measured ethene is not certain. These data suggest that partial dechlorination of TCE was occurring during the demonstration, and that complete reductive dechlorination was limited.

3.6 DISTRIBUTION AND GROWTH OF ADDED DHC

The goal of this performance objective was to achieve adequate distribution and growth of bioaugmented DHC downgradient of the cathodes and throughout the test plot treatment zone, through stimulation with H₂ produced by the proton reduction system. A measured aqueous cell density of $>1.0 \times 10^7$ cells/liter in the test plot treatment zone was required for this performance objective to be considered successful.

3.6.1 Data Requirements

The collection of groundwater DHC data at different time points throughout the demonstration was required to evaluate this performance objective. Pre-bioaugmentation and post-bioaugmentation sampling events were performed in which groundwater samples were obtained from select wells and analyzed using quantitative polymerase chain reaction (qPCR) to determine DHC groundwater concentrations. DHC data collected from wells within the test plot were compared to data collected from one of the MLS background well intervals. The data collected was used to determine the distribution and growth of DHC within the test plot.

3.6.2 Success Criteria

This performance objective was to be considered successful if qPCR data indicated that DHC were distributed downgradient of the injection point, and that DHC concentrations increases *in situ* to $>1.0 \times 10^7$ cells/liter as cVOCs were reduced. DHC data collected during the demonstration indicated a lack of distribution and growth of the bioaugmentation culture during the demonstration.

3.7 ELECTRODE STABILITY FOR >1 YEAR

In order for the treatment system to be successful, consistent and sustained proton reduction and production of H₂ at the cathode needed to be achieved. This required that the electrodes perform continuously, without measureable loss in performance.

3.7.1 Data Requirements

The collection of system operating voltages and currents, and visual observations of the electrode material at multiple time points throughout the demonstration was required to evaluate this performance objective. System operating parameters were recorded at least twice per month, and the electrodes were removed from the wells for inspection approximately once every six months. The data collected was used to determine the operating efficiency of the electrodes during the demonstration.

3.7.2 Success Criteria

This performance objective was to be considered successful if the electrodes operated effectively, without measurable loss of performance for >1 year. Additionally, electrode corrosion observed during inspections must be minimal. Regular system operation measurements collected during the demonstration indicated that there was no significant decrease in electrode performance (i.e. loss of current at a given voltage) during two years of operation. Some fouling of the cathodes was observed during inspections. However, this did not appear to significantly impact electrode performance.

3.8 SYSTEM RELIABILITY AND EASE OF OPERATION

The goal of this performance objective was to assess and maximize the reliability and ease of operation of the solar-powered proton reduction system.

3.8.1 Data Requirements

This performance objective is qualitative, and thus was evaluated using the observations of field personnel and project management. These include logged data collected from the solar power system, and system operating parameters recorded during regular site inspections.

3.8.2 Success Criteria

This performance objective was to be considered successful if the solar-powered proton reduction system operated continually (i.e., for a minimum of 12 months) with minimal downtime and supervision (i.e., less than 8 hours of manpower per month required to successfully operate the system). Field observations and system operating records indicate that the system operated >95% of the time over a 2 year period, with minimal O&M required.

3.9 SUSTAINED SOLAR OUTPUT TO OPERATE THE PRT SYSTEM

The goal of this performance objective was to assess and maximize the reliability and ease of operation of the off-the-grid solar-power system that powered the proton reduction system.

3.9.1 Data Requirements

This performance objective is qualitative, and thus was evaluated by using the observations of field personnel and project management. These include logged data collected from the solar power system, and system operating parameters recorded during regular site inspections.

3.9.2 Success Criteria

This performance objective was to be considered successful if the electrical output derived from the solar power was sufficient to power the proton reduction system for the course of the demonstration (i.e., a minimum of 12 months) with no additional external power required. Field observations and system operating records indicate that the solar power system operated >95% of the time over a 2 year period, with minimal O&M required.

3.10 NO SAFETY HAZARDS OR INCIDENTS DURING SYSTEM OPERATION

The goal of this performance objective was to assess and maximize the safety of operating the solar-power proton reduction system.

3.10.1 Data Requirements

This performance objective is qualitative, and thus was evaluated by using the observations of field personnel and project management. These include safety observations and measurements made during regular site inspections and field activities.

3.10.2 Success Criteria

This performance objective was to be considered successful if there were no observed or recorded safety incidents or hazardous conditions during system operation and monitoring over the course of the demonstration. Safety observations and records indicated that there were no safety incidents or injuries that occurred during the demonstration. A build-up of hydrogen gas was measured in the sealed cathode wells during early operation of the PRT system. Hydrogen buildup was mitigated by opening the valves on the cathode well heads, and drilling holes in the lids of the well vaults to allow hydrogen to dissipate from the wells. No explosive conditions were measured (via combustible gas meter) during the demonstration.

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4.0 SITE DESCRIPTION

A key to the success of any field demonstration project is the selection of an appropriate demonstration site. After reviewing and analyzing data from several potential sites, Area SS-36 at JB MDL, New Jersey (**Figure 4.1**) was selected as the demonstration site for this project. A site selection memorandum was prepared and submitted to ESTCP detailing the following positive characteristics that made Area SS-36 at JB MDL a suitable location for the demonstration:

- TCE or *cis*-DCE in the range of 0.1 to 10 mg/L,
- No or incomplete (i.e., *cis*-DCE stall) dehalogenation of TCE occurring,
- < 100 DHC/mL based on qPCR,
- Low natural groundwater pH (i.e., pH<6),
- A shallow aquifer (<30 ft bgs),
- Relatively permeable soils,
- Available site characterization data,
- Sufficient space for the demonstration plots,
- Potential for full-scale implementation upon successful demonstration,
- Receptive interested parties and regulators,
- Located close to CB&I's Lawrenceville, NJ laboratory, and
- Ongoing remedial activities being performed by CB&I at the site.

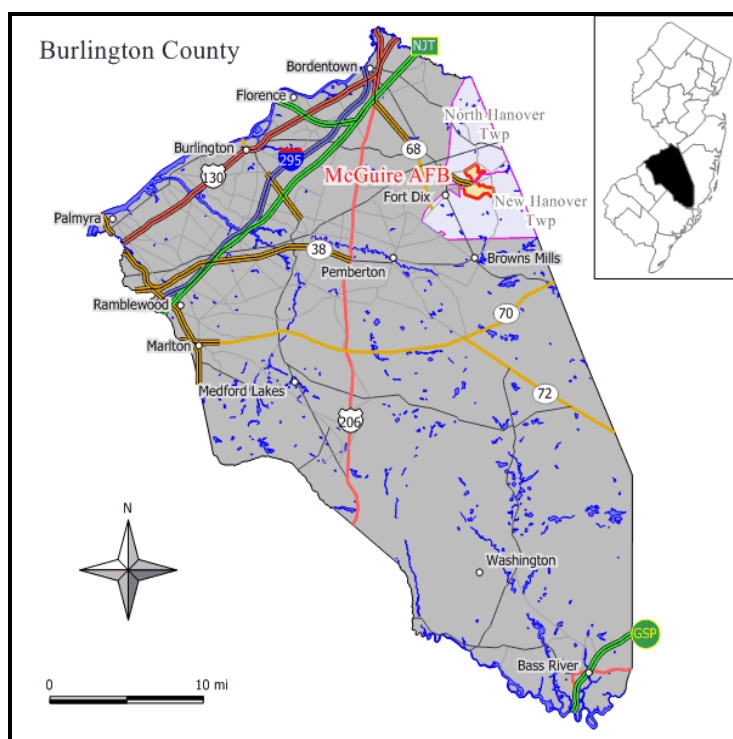


Figure 4.1. Location of JB MDL in New Jersey

4.1 SITE LOCATION AND HISTORY

The SS-36 area is located in a developed portion of JB MDL, and includes buildings, parking lots, and paved roads. A large open grassy area that appeared suitable for this demonstration lies down gradient of building 2305 (**Figure 4.2**). Historical site investigations identified soil contamination (PAHs and pesticides) and groundwater contamination (VOCs, SVOCs, and metals). Area SS-36 includes a partial grouping of industrial facilities that encompasses many of the buildings shown in **Figure 4.2**. Some of the industrial activities performed in this area involve aircraft maintenance and ground equipment support. These facilities use and/or generate large quantities of waste oils and hydraulic fluids, solvents, spent batteries and cells, neutralized lead-acid, and waste paints and thinner. Little is known regarding the former disposal practices. The 2300 industrial facilities (**Figure 4.2**), including Buildings 2305, 2311, and 2315, are associated with structural repair operations where large quantities of waste oil, waste hydraulic fluids, waste solvent, waste Alodine solution, waste thinner, sandblasting material (potentially containing metals), and water curtain sludge (from the filtration system in Building 2315) are used and generated. The 2300 Area also includes the Hazardous Waste Storage Yard (Building 2310), which is the collection point for the hazardous waste program on base. Waste paints, spent batteries, asbestos, PCB transformers, spent solvents, corrosives, waste oils, and waste fuels are collected and stored at Building 2310 before being transported off base.

4.2 SITE GEOLOGY/HYDROGEOLOGY

McGuire AFB is underlain by a succession of aquifers and confining layers. The shallow aquifers are the Cohansey Sand/Kirkwood Formation aquifer system and the Vincentown Formation. The two aquifers are believed to be hydraulically connected, forming a shallow aquifer system that is about 75 ft thick. The Cohansey Sand/Kirkwood Formation aquifer system is the principal water table aquifer of the New Jersey Coastal Plain and covers an area of about 3,000 square miles. These formations generally have unconfined conditions, although confined conditions may occur locally. The Cohansey Sand/Kirkwood Formation aquifer system has total dissolved solids of 500 milligrams per liter (mg/L) or less and is suitable for potable, industrial, or agricultural water supply after conventional water treatment (New Jersey Class GW-2 aquifer). Aquifer recharge mainly occurs through precipitation falling on exposed portions of the two formations.

The shallowest stratigraphic unit at Area 36, and the formation that was targeted for this demonstration, is the Kirkwood Formation. This unit forms the uppermost aquifer system where groundwater occurs under unconfined conditions. The Cohansey Formation, observed in other portions of the base, is not present at this location. The Kirkwood Formation, consisting of a gray to yellow-brown, fine micaceous quartz sand with local beds of clay and silt, reaches a thickness of approximately 29 ft in the demonstration location.

The Vincentown Formation underlies the Kirkwood Formation and is up to 50 ft thick (based on previous site characterization activities) in the JB MDL area. It consists of locally fossiliferous greenish-gray, sometimes clayey, glauconitic quartz sand. The Vincentown Formation has an upper calcarenite member that consists mostly of shell fragments, and a lower glauconite sand member. The presence of glauconite (green to blue-green clay mineral) and fossils, where present, distinguishes the Vincentown Formation from the overlying basal Kirkwood Formation.

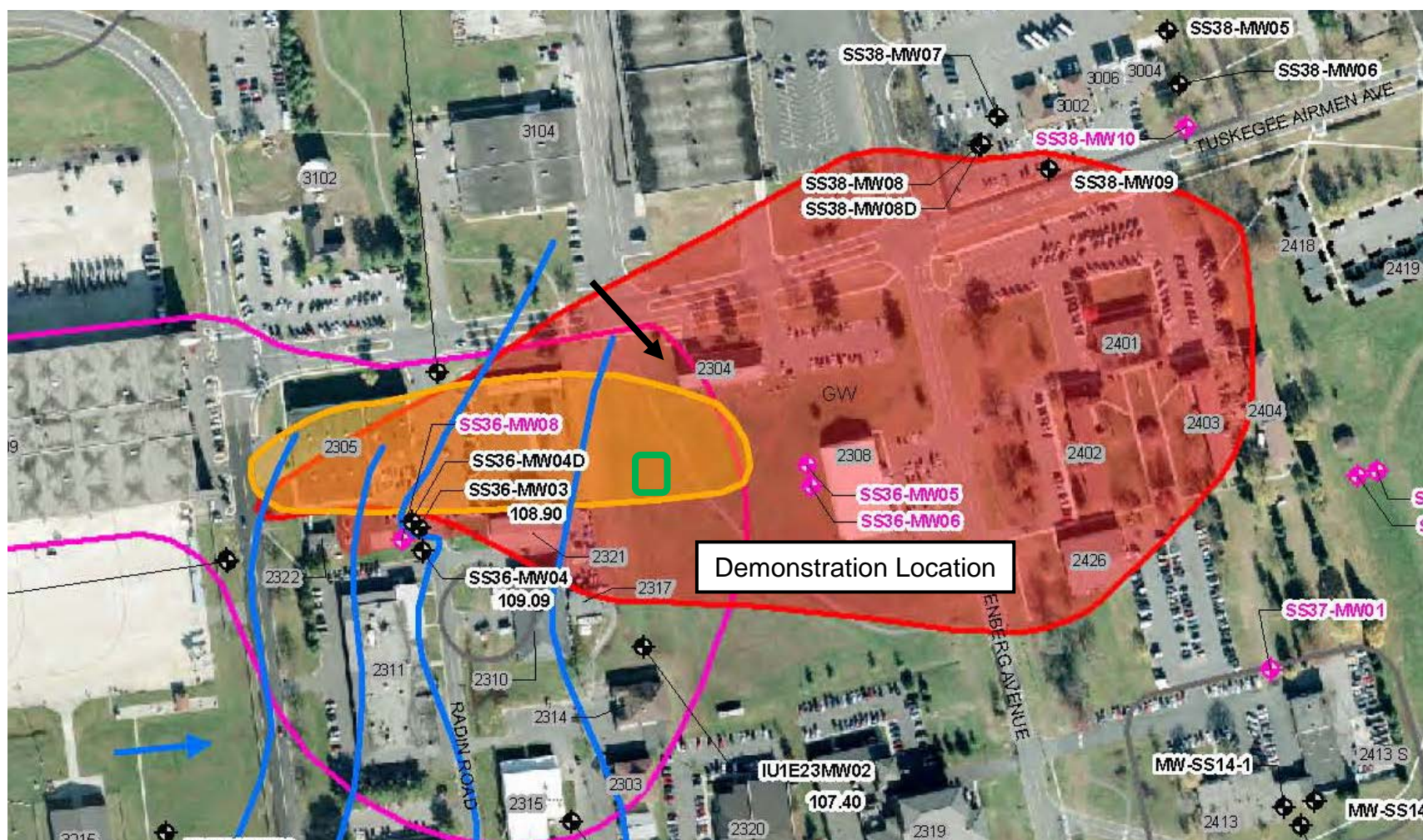


Figure 4.2. Map of the TCE Plume Extending Downgradient from Building 2305 in the SS-36 Area.

The orange area identifies TCE in upper portion of the Kirkwood Formation and the red indicates TCE in the lower portion of the Kirkwood Formation at concentrations >1 µg/L.

On a regional scale, the shallow groundwater at McGuire AFB flows to the east-southeast. On the basis of detailed groundwater information collected from five sites across the Base, the average groundwater flow rate is estimated to be about 0.098 ft/day, or about 36 ft/year. As discussed in **Section 5.2.3**, the estimated linear groundwater velocity in the demonstration area ranged from 0.06 to 0.22 ft/day, or 22 to 80 ft/year. Locally, the groundwater flow direction is typically toward streams and drainage channels, forming complex local flow patterns. Groundwater flow within the Kirkwood Formation in Area SS-36 was determined to be generally to the east, as shown in **Figure 4.2**. Once water infiltrates the hydraulic regime, it flows under water table conditions toward zones of decreasing hydraulic head. The shallow water table system possesses a fairly short flow path. It is estimated that 85 percent of the precipitation that infiltrates to the surficial aquifer system follows a shallow flow path and discharges to a surface water body as base flow. Preliminary groundwater sampling performed by CB&I in August 2010 demonstrated that groundwater pH throughout most of the proposed test area was <6 SU.

Groundwater depth was generally between 7 and 9 ft of the ground surface in the demonstration area during the demonstration. Water levels at JB MDL generally decline during the growing season due to increased evapotranspiration rates. There may be a monthly lag in water level changes, making effects of pumping and precipitation not immediately apparent. Water levels generally reflect seasonal and climatic changes rather than single precipitation events (Tetra Tech, 2008).

The series of aquifers and low permeability confining units underlying JB MDL minimizes the impact of shallow groundwater contamination to the deeper aquifers. Likewise the artesian conditions and upward vertical gradients for the deeper aquifers beneath JB MDL restrict the downward migration of surface contamination.

Site characterization activities, including continuous soil core collection, were performed by CB&I as part of baseline characterization activities (**Section 5.2**). The soil cores collected during these activities were used in the generation of a cross section (**Figure 4.3**) showing the generalized subsurface stratigraphy of the demonstration area, and in the development of the Conceptual Site Model (CSM) (**Section 5.4.1**). The general subsurface stratigraphy is summarized as follows:

- Layer 1: Dark gray silty fine sand with sandy/silty clay and silt interbeds from ground surface to approximately 19 ft bgs,
- Layer 2: Medium gray, medium to coarse sand from approximately 19 to 20 ft bgs (this layer ranged from approximately 6 to 24 inches in thickness),
- Layer 3: Dark gray silt and very fine sand from approximately 20 to 22 ft bgs,
- Layer 4: Dark Gray clayey silt/sand from approximately 22 to 29 ft bgs, and
- Layer 5: Dark greenish gray fine sand below 29 to 30 ft bgs.

Layers 1 through 4 were determined to be part of the Kirkwood Formation, while Layer 5 is presumed to be the uppermost portion of the Vincentown Formation.

4.3 CONTAMINANT DISTRIBUTION

The nature and extent of subsurface soil and groundwater contaminants (e.g., VOCs, SVOCs, metals, pesticides, and PCBs), including potential VOC source areas, were not fully delineated at the SS-36 area prior to the demonstration. **Figure 4.2** provides a 2009 map of the TCE plume extending down gradient from building 2305 in the SS-36 area of JB MDL. The area shaded orange in the figure identifies TCE at measured concentrations >1 $\mu\text{g/L}$ in the upper portion (generally above 19 ft bgs) of the Kirkwood Formation. This portion of the aquifer generally includes Layer 1, as detailed above. The area shaded in red indicates TCE at measured concentrations >1 $\mu\text{g/L}$ in the lower portion (approximately 19-25 ft bgs) of the Kirkwood Formation. This portion of the aquifer generally includes Layers 2, 3, and the upper portion of Layer 4.

As part of ongoing remedial investigations at the site, a direct-push groundwater sampling program was conducted in September 2009 by CB&I (formerly Shaw Environmental) under a separate contract. Results from the sampling program performed in the SS-36 area in the general vicinity of the demonstration location are provided in **Table 4.1**. The results indicated that TCE concentrations in the lower portion of the Kirkwood ranged from approximately 2,000 $\mu\text{g/L}$ to $>120,000$ $\mu\text{g/L}$, with the highest concentrations observed towards the centerline of the plume. The existence of *cis*-DCE and small amounts of vinyl chloride suggested that some biological dechlorination may be occurring at this site.

These data, along with site hydrogeologic and geochemical data collected during demonstration site characterization activities (**Section 5.2**) were used to construct the CSM. The CSM indicates that groundwater and dissolved contaminants flow preferentially in an eastern horizontal direction (**Figure 4.2**) through the high permeability medium-coarse sand layer (Layer 2, **Figure 4.3**). Some of these contaminants have diffused (or continue to diffuse) into the underlying silt and very fine sand layer (Layer 3), and the upper portion of the lower permeability clayey silt/sand layer (Layer 4). The direction of vertical diffusion is dependent on the concentration gradient between these layers. However, based on the soil VOC data collected, it is likely that, in addition to upgradient sources, Layer 3 and the upper portion of Layer 4 act as continuing sources of contamination to Layer 2 (i.e., back-diffusion is occurring). Site characterization data indicate that Layer 1 has low levels of contamination, when compared to Layers 2 and 3, and Layer 5 exhibits no contamination in the demonstration area. Therefore, *in situ* treatment during this demonstration focused on Layers 2 and 3. However, the upper portion of Layer 4 was also monitored to determine if hydrogen can be distributed or produced within this clayey silt/sand material

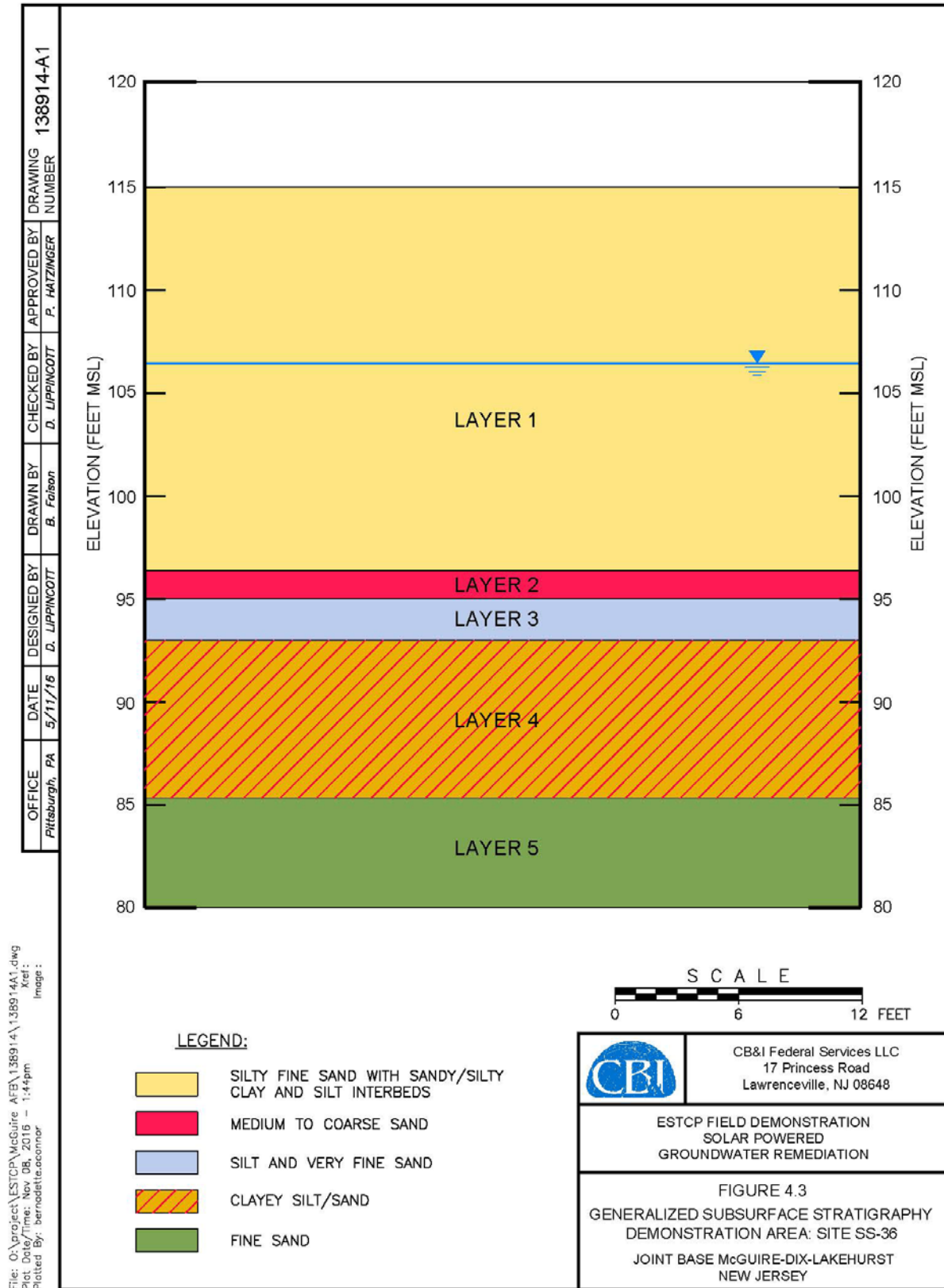


Figure 4.3. Generalized Subsurface Stratigraphy at Site SS-36

Table 4.1. Analysis of Direct-Push Groundwater Samples Collected in the SS-36 Area of JB MDL

Sample ID	Compound	Concentration (µg/L)	GWQC (µg/L)
GW28A (10-15')	TCE	586	1.0
	<i>cis</i> -DCE	266	70
	VC	5.8	1.0
	1,1-DCE	1.2	1.0
GW28B (21-26')	TCE	2,230	1.0
	<i>cis</i> -DCE	322	70
	1,1-DCE	2.0	1.0
GW29A (10-15')	TCE	23.1	1.0
GW29B (19-24')	TCE	17,500	1.0
	<i>cis</i> -DCE	368	70
	VC	3.0	1.0
	1,1-DCE	6.9	1.0
GW30A (8-13')	TCE	76.7	1.0
GW30B (20-25')	TCE	121,000	1.0
	<i>cis</i> -DCE	3,000	70
	VC	4.4	1.0
	1,1-DCE	22.5	1.0
	Benzene	5.2	1.0
GW31A (8-13')	TCE	157	1.0
GW31B (20-25')	TCE	79,000	1.0
	<i>cis</i> -DCE	6,920	70
	VC	18.5	1.0
	1,1-DCE	3.1	1.0
	Benzene	9.6	1.0
GW32A (9-14')	TCE	74.3	1.0

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5.0 TEST DESIGN

5.1 CONCEPTUAL EXPERIMENTAL DESIGN

This field demonstration project used electrodes inserted into PVC wells in a CVOC-contaminated, low pH, aquifer. The electrodes were operated in an effort to generate H_2 to support biodegradation, and consume H^+ and produce OH^- to increase aquifer pH. The contaminated aquifer was inoculated with a bioaugmentation culture to ensure that the appropriate dechlorinating bacteria were present to support biodegradation. Electricity to operate the system was provided by solar panels and deep cycle 12 V batteries. During the demonstration, we monitored groundwater pH, contaminant concentrations, H_2 production, distribution and utilization, and electrode performance.

5.2 BASELINE CHARACTERIZATION

Baseline testing and site characterization were performed to generate the data needed to design the field system. Testing included a direct-push site investigation to evaluate aquifer geology and contaminant distribution, monitoring well installation and hydrogeologic testing to evaluate site hydrogeology, geochemical characterization of site groundwater and soils, and geochemical modeling. The results of these activities are summarized in the following subsections. Final system conceptual design was based on results of these baseline characterization activities, as well as laboratory testing activities detailed in **Section 5.3**.

5.2.1 Direct-Push Investigation

A direct-push investigation was conducted to identify the optimal location for the field demonstration, improve delineation of the stratigraphy in the field demonstration test area, and to further evaluate the vertical and lateral contaminant distribution. Information obtained from this investigation was used to optimize/verify well screen intervals for the injection/extraction and monitoring wells, and confirm that the test plot and control plot are located within the TCE plume. Thus, data collected during the direct-push investigation were used to improve the conceptual site geologic model (**Section 5.4.1**), to determine the layout of the demonstration test and control plots, and to verify the depth of the selected treatment interval.

During the direct-push investigation, four soil borings (DP-01-SB through DP-04-SB) and four discrete interval groundwater sampling borings (DP-01-GW through DP-04-GW) were advanced at four separate locations within the Site SS-36 plume (**Figure 5.1**). Continuous soil cores collected from the soil borings were characterized in the field by a geologist, and two discrete soil samples were collected for VOC analysis. Additionally, two discrete interval groundwater samples were collected for VOC analysis at each of the groundwater sampling borings. VOC samples were hand delivered to CB&I's laboratory and analyzed within 24 hrs to determine the best location for further characterization. Analytical results from the soil and groundwater analysis are provided in **Tables 5.1** and **5.2**, respectively. Based on the contaminant concentration data and observed geology, the area where borings DP-02-SB and DP-02-GW were advanced was selected as the location for demonstration. As shown in **Figure 5.1**, a 25 ft x 30 ft area was identified as the demonstration area. Additional detailed characterization activities were performed within this area.



Figure 5.1. Location of Initial Soil & Groundwater Sampling Locations within SS-36 Plume

Table 5.1. Summary of Initial SS-36 Direct-Push Characterization Soil Sampling Data

Sample Location ID	DP-01-SB				DP-02-SB				DP-03-SB				DP-04-SB			
Sample Depth (ft. bgs)	20.5'		22.5'		20.25'		21.0'		21.0'		21.5'		20.0'		22.0'	
Layer	2		3		2		3		2		3		2		3	
VOCS (GC/MS)	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
chloromethane	539	U	97.9	J	426	U	554	U	92.3	J	525	U	441	U	455	U
bromomethane	539	U	462	U	426	U	554	U	448	U	109	J	441	U	455	U
cis-1,2-dichloroethylene	539	U	462	U	426	U	554	U	448	U	717	D	441	U	1173	D
1,1,1-trichloroethane	175	J	462	U	426	U	554	U	448	U	525	U	441	U	455	U
trichloroethylene	2330	D	971	D	184	J	19200	D	7060	D	64300	D	3610	D	15710	D
acetone	1078	U	924	U	851	U	3120	D	896	U	1049	U	883	U	2467	D
Soil moisture	%		%		%		%		%		%		%		%	
% moisture	21.61		11.56		11.10		23.18		12.59		24.19		13.35		20.72	

U - The compound was not detected at the indicated concentration.

J - Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than zero. The concentration given is an approximate value.

D - Sample was diluted prior to analysis.

Table 5.2. Summary of Initial SS-36 Direct-Push Characterization Groundwater Sampling Data

Sample Location ID	DP-01-GW				DP-02-GW				DP-03-GW				DP-04-GW			
Sample Interval (ft. bgs)	17-20'		21-24'		15-18'		19-21'		15-18'		20-23'		15-18'		19.5-21.5'	
Layer	2		3		2		3		2		3		2		3	
VOCs (GC/MS)	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
cis-1,2-dichloroethylene	178	J	30.7	J	<5		158		<5		1540		<5		3450	
trichloroethylene	4510		789		<5		9202		1.3	J	58600		6.7		55700	
Field Parameters																
Temperature (°C)	25.83		24.58		24.15		21.35		20.39		19.59		27.87		20.44	
Conductivity (mS/cm)	0.322		0.345		0.210		0.248		0.170		0.223		0.002		0.279	
pH (SU)	4.70		4.72		4.12		4.67		4.46		4.76		4.72		4.57	
ORP (mV)	103.4		99.7		260.1		127.3		248.7		40.7		196.5		47.1	
Turbidity (NTU)	113.1		177.2		1394.4		1364.6		1354.0		1046.5		NS		1050	
DO (mg/L)	1.88		2.21		1.22		1.79		3.28		3.79		6.53		3.47	

J - Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than zero. The concentration given is an approximate value.

A total of four continuous soil cores (DP-02-SB, DP-05-SB, DP-06-SB and DP-07-SB) were collected to a total depth between 25 and 30 ft bgs within the selected demonstration location (**Figure 5.2**). The soil cores were logged by a Shaw geologist to determine subsurface stratigraphy. The observed stratigraphy within the upper 30 ft of the demonstration area has been segregated into 5 distinct layers, as described in **Section 4.2**, and as shown in the generalized geologic cross section provided in **Figure 5.3**.

Two cVOC soil samples were collected from each of the four borings within the demonstration area, based on measured photoionization detector (PID) readings. PID data suggested that cVOC concentrations were the greatest [generally between 2 and 60 ppm] in Layers 2 and 3. PID readings in the stratigraphic layers overlying and underlying these layers (Layers 1 and 4, respectively) were generally zero ppm. Analytical data collected from the soil samples indicated that the highest cVOC concentrations (primarily TCE) were found in Layer 3. Soil TCE concentrations in Layer 3 ranged from 19.2 mg/kg to 92.2 mg/kg, while soil TCE concentrations in Layer 2 ranged from 0.18 mg/kg to 1.95 mg/kg. A summary of soil cVOC data (detected compounds only) is provided in **Table 5.3**. These data indicate that, while a significant mass of TCE is present within the higher permeability medium to coarse sand (Layer 2), the bulk of the TCE mass resides within the underlying lower permeability silt and very fine sand (Layer 3).

Table 5.3. Summary of Demonstration Area Direct-Push Soil Sampling Data

Sample Location ID	DP-02-SB		DP-05-SB		DP-06-SB		DP-07-SB	
Sample Depth (ft. bgs)	20.25'	21.0'	19.5'	22'	19.5'	20.5'	19.5'	20.5'
Layer	2	3	2	3	2	3	2	3
VOCS (GC/MS)	mg/kg		mg/kg		mg/kg		mg/kg	
chloromethane	426	U	554	U	463	U	512	U
bromomethane	426	U	554	U	463	U	512	U
cis-1,2-dichloroethylene	426	U	554	U	463	U	512	U
trichloroethylene	184	J	19200	D	1580	D	92200	D
bromodichloromethane	426	U	554	U	463	U	512	U
acetone	851	U	3120	D	2610	D	967	U
Soil moisture	%		%		%		%	
% moisture	11.10	23.18	15.78	20.63	15.03	24.15	16.15	25.55

U - The compound was not detected at the indicated concentration.

J - Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than zero. The concentration given is an approximate value.

D - Sample was diluted prior to analysis.

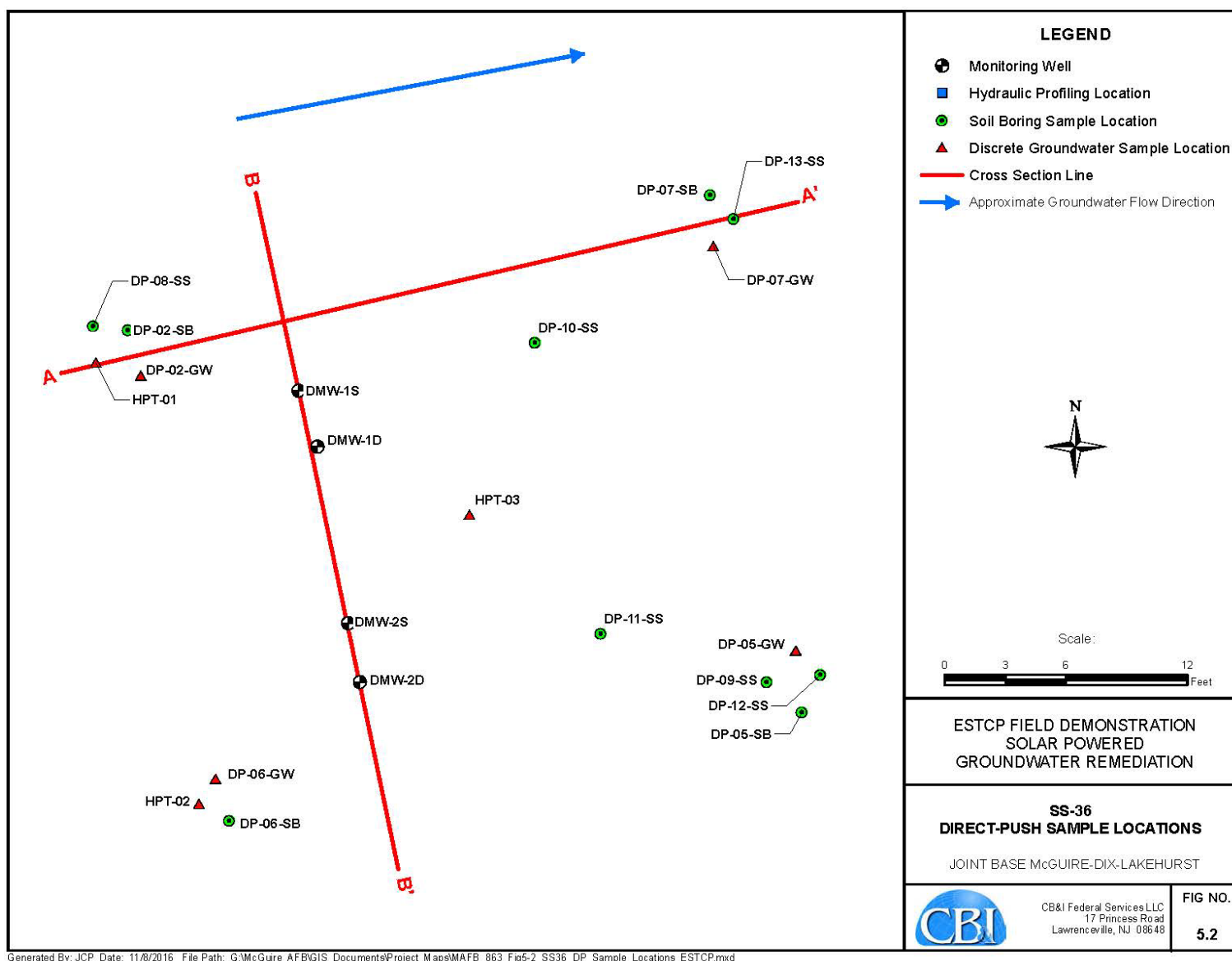


Figure 5.2. Direct-Push Boring and Monitoring Well Pair Locations in the Selected Demonstration Area

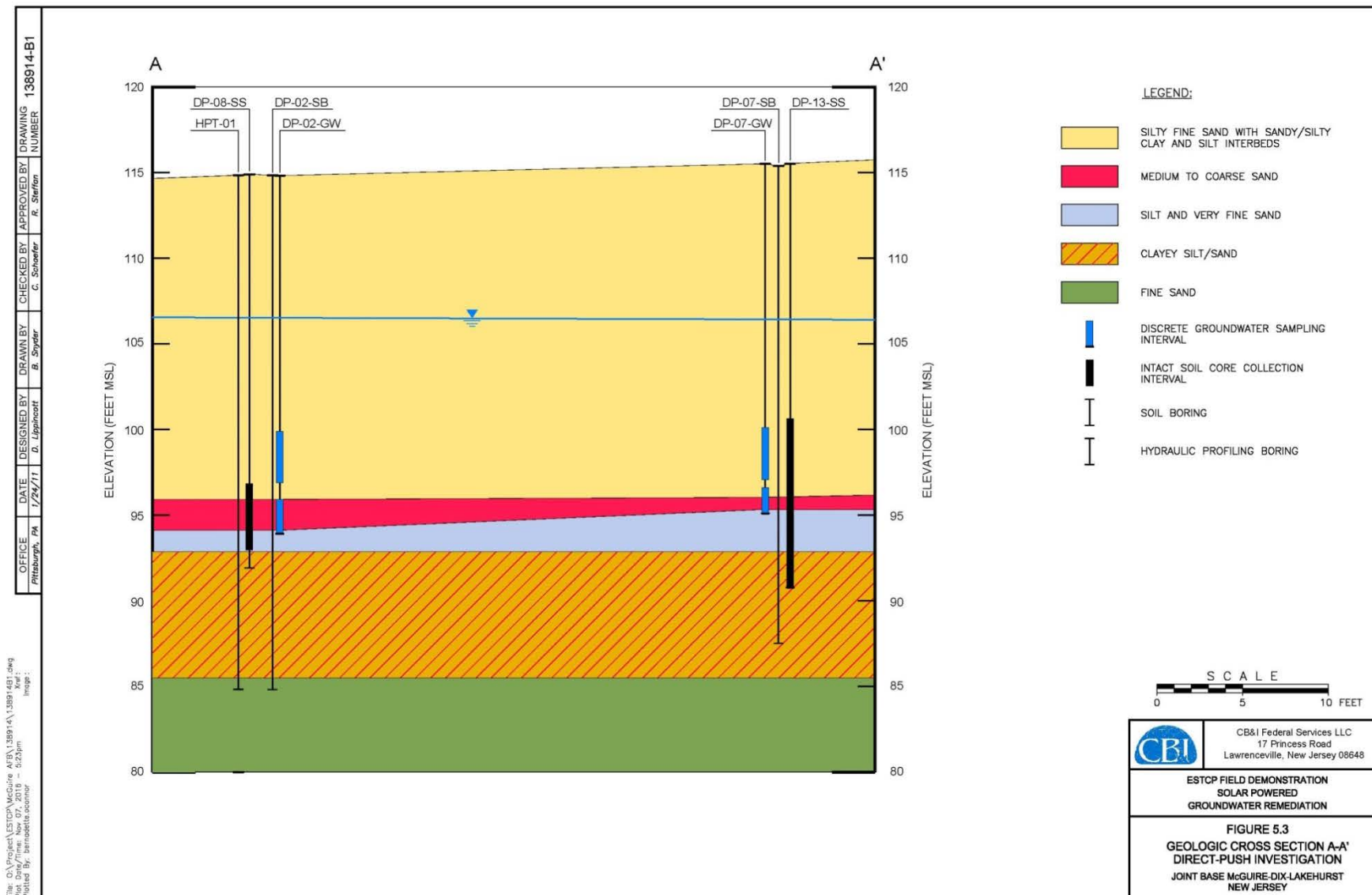


Figure 5.3. Geologic Cross Section of Demonstration Area Showing Soil Borings and Groundwater Sampling Intervals

Two discrete interval groundwater cVOC samples were collected at locations adjacent to each of the four continuous soil coring locations using direct-push methods. These locations (DP-02-GW, DP-05-GW, DP-06-GW, AND DP-07-GW) are shown on **Figure 5.1**. Field parameters (temperature, specific conductivity, pH, oxidation-reduction potential, and dissolved oxygen) were also collected with each sample. Each discrete groundwater sample was collected over a 3 ft interval. The upper sample was collected within the lower portion of Layer 1, and the lower sample was collected across Layers 2 and 3. Analytical and field parameter data are summarized in **Table 5.4**. Groundwater TCE concentrations in the upper samples ranged from non-detect (<5 µg/L) to 189 µg/L, while concentrations in the lower samples ranged from 5,180 µg/L to 13,300 µg/L. These data are in agreement with the soil analytical and PID data, indicating that Layer 1 is relatively uncontaminated, and that the bulk of the TCE mass reside within layers 2 and 3 (primarily Layer 3). Groundwater pH levels in these samples ranged from 4.12 to 5.05 SU. Groundwater samples were also collected for geochemical analysis, as detailed in **Section 5.2.4**.

Six additional soil borings (DP-08-SS through DP-13-SS) were advanced to collect discrete zone soil cores for analysis of soil geochemical properties (**Section 5.2.4**) and/or use in the various laboratory testing detailed in **Section 5.3**. Three additional direct-push borings (HPT-01 through HPT-03) were advanced for hydraulic profile testing (HPT) to evaluate subsurface permeability with depth (**Figure 5.2**). However, problems with the HPT equipment during advancement of the probe made the data obtained unreliable. Therefore, these data are not presented.

Utility clearances, Health & Safety procedures, and decontamination of drilling and sampling equipment during the direct-push investigation activities were all conducted in accordance with procedures detailed in the Demonstration Work Plan (Shaw, 2012).

Table 5.4. Summary of Demonstration Area Direct-Push Groundwater Sampling Data

Sample Location ID	DP-02-GW		DP-05-GW		DP-06-GW		DP-07-GW		
Sample Interval (ft. bgs)	15-18'	19-21'	18-20'	21-23'	18.5-20'	21-24'	15.5-18.5	19-20.5	21-24
Layer	2	3	2	3	2	3	1	2	3
VOCs (GC/MS)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
cis-1,2-dichloroethylene	<5	158	<5	242	<5	108	<5	12.9	129
trichloroethylene	<5	9202	189	13300	101	5180	8.5	792	7900
Field Parameters									
Temperature (°C)	24.15	21.35	21.41	18.88	21.91	21.99	22.31	21.05	20.41
Conductivity (mS/cm)	0.210	0.248	0.378	0.518	0.376	0.566	0.405	0.357	0.437
pH (SU)	4.12	4.67	4.98	4.24	4.31	5.03	4.97	4.90	4.47
ORP (mV)	260.1	127.3	52.9	32.6	250.7	100.6	131.5	107.2	35.7
Turbidity (NTU)	1394.4	1364.6	236.8	1067.6	649	228	1408.4	1395.1	850.3
DO (mg/L)	1.22	1.79	3.09	2.58	2.11	2.80	3.31	1.71	4.55

5.2.2 Monitoring Well Installation and Sampling

Four monitoring wells (DMW-1S, DMW-1D, DMW-2S, and DMW-2D) were installed using direct-push drilling methods within the demonstration area in October, 2010 (**Figure 5.2**). Based on data collected during the direct-push investigation, monitoring wells DMW-1S and DMW-2S were screened across Layers 1 and 2, while monitoring wells DMW-1D and DMW-2D were intended to be screened across Layers 3 and 4 (**Figure 5.4, Table 5.5**). Groundwater samples were collected from three of the four wells on November 8, 2010 using low flow sampling methods. Monitoring well DMW-2D could not be sampled, due to extremely low recharge.

Table 5.5. Summary of As-Built Characterization Monitoring Well Construction Details

WELL ID	GROUND SURFACE ELEVATION (FT MSL)	TOP OF CASING ELEVATION (FT MSL)	WELL DIAMETER (IN)	BOREHOLE DIAMETER (IN)	TOP OF SCREEN (FT BGS)	BOTTOM OF SCREEN (FT BGS)	TOP OF FILTER PACK (FT BGS)	BOTTOM OF FILTER PACK (FT BGS)	TOP OF SEAL (FT BGS)	BOTTOM OF SEAL (FT BGS)
DMW-1S	114.94	114.71	2.0	5.0	15.2	20.2	15.2	20.2	1.0	15.2
DMW-1D	114.97	114.61	2.0	5.0	20.6	25.6	19.6	25.6	1.0	19.6
DMW-2S	115.06	114.71	2.0	5.0	14.5	19.5	13.5	19.5	1.0	13.5
DMW-2D	115.06	114.64	2.0	5.0	20.6	25.6	24.8	25.6	1.0	24.8

A summary of groundwater cVOC data (detected compounds only) and field parameter data are provided in **Table 5.6**. Groundwater TCE concentrations ranged from 7,610 µg/L to 9,450 µg/L, which is consistent with the groundwater TCE data collected during the direct-push investigation. Groundwater pH levels ranged from 4.01 to 5.15 SU.

As discussed in **Section 5.2.3**, it appears that the filter pack and/or screen interval for monitoring well DMW-1D was installed at least partially into the medium to coarse sand layer (layer 2), and that the majority of the groundwater collected during the sampling of this well most likely from Layer 2 (which has a much higher hydraulic conductivity than layers 3 and 4).

5.2.3 Hydrogeologic Testing

Rising head and falling head slug tests were performed at the four demonstration area monitoring wells in December, 2010. A summary of slug testing results is provided in **Table 5.7**. The results indicate estimated hydraulic conductivity (K) values range between 1.3 ft/day and 5.0 ft/day in wells DMW-1S, DMW-1D, and DMW-2S, and an estimated K of 0.02 ft/day (approximately 2 orders of magnitude lower) in well DMW-2D. These data suggest that the filter pack and/or screen interval for monitoring well DMW-1D was installed at least partially into the medium to coarse sand layer (Layer 2), and that monitoring well DMW-2D is screened entirely within the underlying silt and very fine sand and clayey silt/sand layers (Layers 3 and 4). These K values are consistent with literature values for the identified stratigraphy (medium to coarse sand and clayey silt, respectively) identified during site characterization activities (Fetter, 1994).

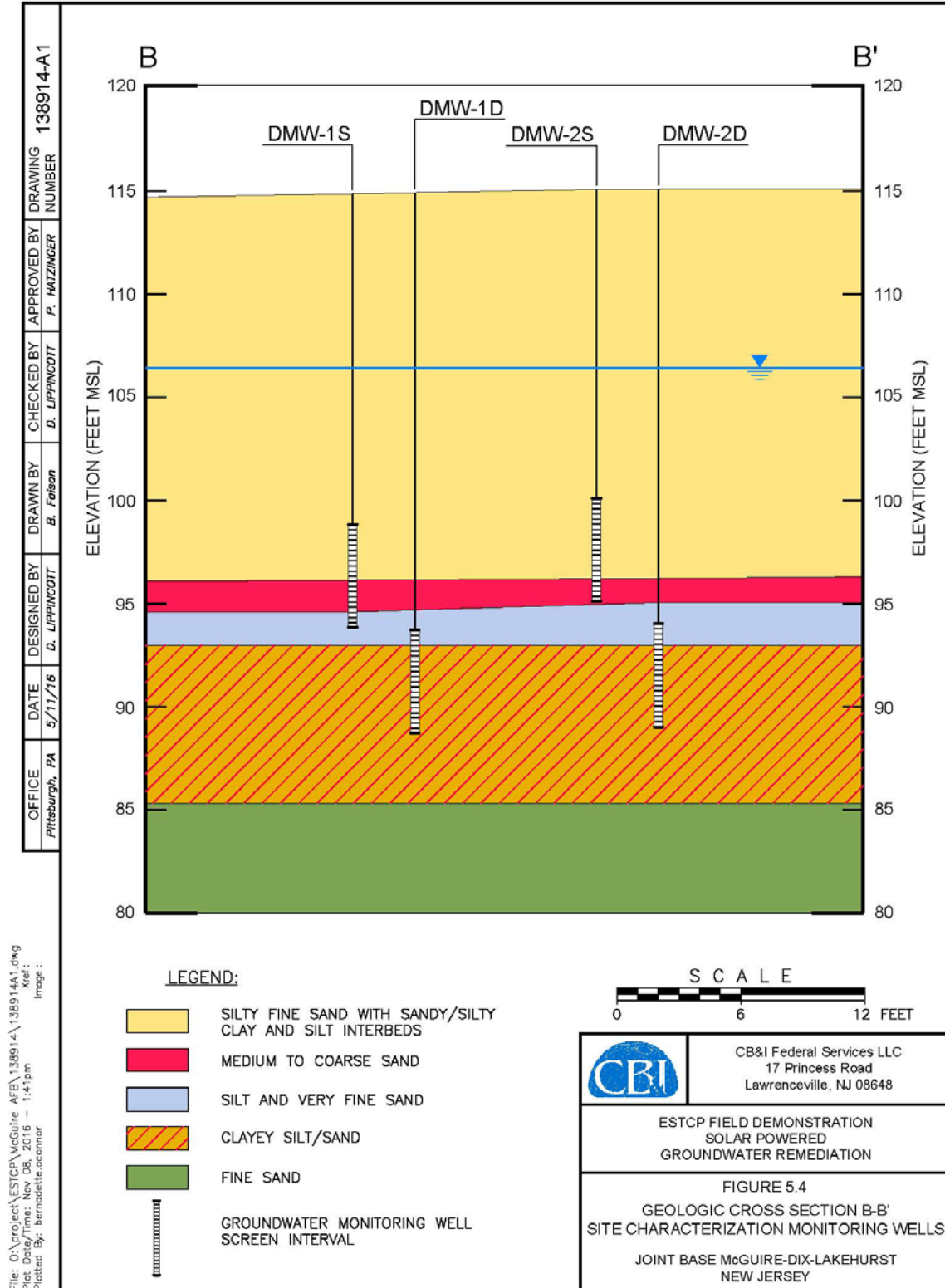


Figure 5.4. Geologic Cross Section Showing Shallow/Deep Paired Monitoring Wells

Table 5.6. Analysis of Groundwater Collected from Three Monitoring Wells.

Parameter	Method	Unit	Wells		
			DMW-1S	DMW-2S	DMW-1D
pH open system	YSI Field Meter	SU	5.91	4.51	4.84
pH closed system	EPA 150.1	SU	4.5	NA	4.31
Redox potential (Eh)	YSI Field Meter	mV	-113.2	50.7	-69.8
Temperature	YSI Field Meter	°C	15.5	16	16.1
Dissolved oxygen (DO)	YSI Field Meter	mg/L	0.25	0.35	0.27
Dissolved Hydrogen	EPA 3810, RSK-175m	µg/L	0.027	0.081	0.822
Dissolved Nitrogen	EPA 3810, RSK-175m	mg/L	14.7	15.6	13.3
Alkalinity as CaCO ₃	EPA 310.1	mg/L	82.8	5.24	6.5
Contents of anions:	EPA 300.0				
Chloride		mg/L	18	25.2	18.3
Sulfate		mg/L	83.3	100	99.1
Phosphate as P, ortho		mg/L	< 0.2 (U)	< 0.2 (U)	< 0.2 (U)
Nitrate as N		mg/L	< 0.2 (U)	< 0.2 (U)	< 0.2 (U)
Nitrite as N		mg/L	< 0.2 (U)	< 0.2 (U)	< 0.2 (U)
Bromide		mg/L	0.41	0.67	0.46
Sulfide		mg/L	< 0.2 (U)	< 0.2 (U)	< 0.2 (U)
Contents of metals/cations:	EPA 6010/200.7				
Iron, Ferric		µg/L	770	770	<500
Iron, Ferrous		µg/L	5900	8200	7000
Aluminum		µg/L	1290	1770	1720
Cadmium		µg/L	< 3.0 (U)	<3.0 (U)	< 3.0 (U)
Calcium		µg/L	< 5000 (U)	<5000 (U)	<5000 (U)
Copper		µg/L	< 10 (U)	< 10 (U)	< 10 (U)
Lead		µg/L	< 3.0 (U)	< 3.0 (U)	< 3.0 (U)
Magnesium		µg/L	6260	8520	6430
Manganese		µg/L	74.7	98.1	68.8
Nickel		µg/L	15.6	23.1	16.3
Potassium		µg/L	<10000 (U)	<10000 (U)	<10000 (U)
Sodium		µg/L	19100	14900	14300
Zinc		µg/L	<20 (U)	29.7	<20 (U)
Total dissolved solids (TDS)	EPA 160.1	mg/L	170	164	147
Total suspended solids (TSS)	EPA 160.2	mg/L	23	6 (J)	7 (J)
Total organic carbon (TOC)	EPA 415.1	mg/L	2.81	2.79	2.76
Ammonia as NH ₃ -N	EPA 350.2	mg/L	0.32 (J)	0.26 (J)	0.26 (J)
Methane	EPA 3810, RSK-175	µg/L	119	284	77
Ethane	EPA 3810, RSK-175	µg/L	<4.0 (U)	<4.0 (U)	<4.0 (U)
Ethene	EPA 3810, RSK-175	µg/L	<5.0 (U)	<5.0 (U)	<5.0 (U)
Trichloroethylene (TCE)	SW846 8260b	µg/L	7610	9370	9450
<i>cis</i> -1,2-Dichloroethene (<i>cis</i> -DCE)	SW846 8260b	µg/L	153	212	156
Vinyl Chloride (VC)	SW846 8260b	µg/L	<42 (U)	<42 (U)	<42 (U)
Acetate	EPA 300.0m	mg/L	<1.0 (U)	<1.0 (U)	<1.0 (U)
VFA	EPA 300.0m	mg/L	<1.0 (U)	<1.0 (U)	<1.0 (U)

(U), Compound not detected above the indicated PQL.

(J), Compound detected above the calculated MDL but below the method PQL.

NA, Not Applicable.

Table 5.7. Summary of JB MDL Slug Test Results and Estimated Groundwater Velocities

Well	Falling Head Test (ft/day)			Rising Head Test (ft/day)			Average of Both Tests (ft/day)	Estimated Groundwater Gradient	Estimated Groundwater Velocity (ft/day)	Estimated Groundwater Velocity (ft/month)
	Hvorslev	Bouwer-Rice	Average	Hvorslev	Bouwer-Rice	Average				
DMW-1S	1.729	1.353	1.541	1.180	0.949	1.065	1.303	0.0066	0.057	1.72
DMW-1D	NA	NA	NA	4.542	3.667	4.105	4.105	0.0066	0.181	5.42
DMW-2S	5.736	4.528	5.132	5.595	4.294	4.945	5.038	0.0066	0.222	6.65
DMW-2D	0.020	0.017	0.019	NA	NA	NA	0.019	0.0066	0.001	0.02

NA - Not Applicable

Additionally, a short-term (~3 hr) constant rate pump test was performed at monitoring well DMW-2S to further evaluate K values, as well as to estimate aquifer transmissivity (T) and storativity (S). Analyses of the pumping and recovery test data are provided in **Appendix B**. With the exception of monitoring well DMW-2D, the K values are comparable to those determined during slug testing, ranging from 4.8 ft/day to 8.7 ft/day. The K value for well DMW-2D calculated from the pump test was 4.2 ft/day, which is significantly higher than the K value estimated from the slug testing. This is most likely due to the fact that the software used to analyze the pumping test data (*Aquifer Test*) is not designed for solving pump tests in heterogeneous aquifers. With the pumping well screened above DMW-2D, and in a more conductive zone, the program/equation likely interpreted this as artificially high conductivity. The minimal amount of drawdown and the slow recovery observed at well DMW-2D, along with data collected during slug testing and well development, indicate that this well is screened within a low permeability unit. These data together suggest that the K value estimated for well DMW-2D from the slug testing is more reasonable than that determined from the pump testing software.

Historical data collected from numerous monitoring wells surrounding the demonstration area indicate that the groundwater gradient of the unconfined aquifer is relatively flat (approximately 0.0066). Using the hydraulic conductivity and groundwater gradient information collected, and an estimated effective porosity of 0.15, linear groundwater velocities for each of the four monitoring wells were calculated (**Table 5.7**). These data indicate an estimated linear groundwater velocity ranging from 0.06 and 0.22 ft/day at well DMW-1S, DMW-1D, and DMW-2S, and an estimated linear velocity of 0.001 ft/day at well DMW-2D.

The hydrogeologic testing results, along with vertical contaminant distribution data collected during the direct-push investigation, were used to select the most appropriate screen intervals for the field demonstration injection/extraction and monitoring wells. These data were also used to refine the CSM (**Section 5.4.1**), and in the building of a three-dimensional groundwater flow model for the demonstration area (**Section 5.4.3**).

5.2.4 Groundwater and Soil Geochemical Characterization

As discussed in **Section 5.2.1**, soil samples were collected from continuous soil cores for geochemical analysis. Three grab samples were collected from select intervals from soil cores DP-08-SS and DP-09-SS (**Figures 5.2 and 5.3**). Samples were analyzed for numerous parameters, as summarized in **Table 5.8**. As expected, the soil pH was acidic, ranging from pH 4.3 to 4.5 across the depth intervals, and there was no clear pH gradient or differences across the different depth profiles. The soils were relatively low in chloride and sulfate, and devoid of nitrate, nitrite, phosphate, and carbonate. Dissolved iron concentrations also were relatively low. The cation exchange capacities measured for the soils were within typical ranges for sandy or silty soils, with the highest values measured in the more permeable layers of the cores. Total organic carbon content of the soils analyzed ranged from 739 mg/kg to 26,200 mg/kg, with higher concentrations generally corresponding to the lower permeability layers, which are likely to contain more naturally occurring organic carbon than the higher permeability sand units.

Groundwater samples were collected from newly installed monitoring wells DMW-1S, DMW-2S and DMW-1D for geochemical characterization. Samples were collected in anaerobic (nitrogen purged) 18-liter sterile stainless steel closed kegs to prevent escape of carbon dioxide. The kegs were refrigerated (4°C) upon arrival at CB&I's Analytical Laboratory (Lawrenceville, NJ). Samples were analyzed for numerous parameters, as summarized in **Table 5.6**. The pH of the groundwater ranged from 4.51 to 5.91, with alkalinity ranging from 5.24 mg/L to 82.8 mg/L. The pH of 5.91 and alkalinity of 82.8 mg/L measured in DMW-1S groundwater are both significantly higher than other samples collected at the site. It is suspected that the bentonite seal or cement/bentonite grout came into contact with the well screen interval during the construction of this well, thus leading to an increase in pH and alkalinity of groundwater samples collected at this well. The pH and alkalinity measurements collected from wells DMW-2S and DMW-1D are considered more typical for this aquifer.

The groundwater samples had chloride concentrations ranging from 18.0 mg/L to 25.2 mg/L, and sulfate concentrations ranging from 88.3 mg/L to 100 mg/L. The samples were devoid of nitrate, nitrite, and phosphate. Ferrous iron concentrations ranged from 5,900 µg/L to 8,200 µg/L, while ferric iron concentrations were relatively low, ranging from non-detect (<500 µg/L) to 770 µg/L. Total organic carbon concentrations were low, ranging from 2.76 mg/L to 2.81 mg/L. Groundwater DO measured in the field ranged from 0.25 mg/L to 0.35 mg/L, and ORP ranged from -113.2 mV to +50.7 mV, respectively. These field data suggest that the aquifer is moderately reducing.

5.2.5 Geochemical Modeling

As part of the work at JB MDL, we applied the groundwater and mineralogy characterization data that were collected to geochemical models to predict how groundwater pH can be increased and to assess the impact of the pH increase on mineral precipitation. The goal of the modeling was to 1) determine at what pH the cathode water should be maintained to limit precipitation, and 2) to assess the potential for aquifer plugging as a result of mineral precipitation. Specifically, we evaluated groundwater compositions from three wells (DMW-1S, DMW-2S, and DMW-1D) with a focus on determining the pH at which mineral precipitation was predicted to occur. These computer simulations, performed using Geochemist's Workbench software

(Rockware, Golden, Colorado), computationally titrated 0.005 moles H₂ and 0.001 moles goethite into one liter of groundwater to simulate the generation of elemental hydrogen at the electrode. Increases in pH were observed in each case due to the reduction of sulfate to sulfide. Mineral precipitation results were:

- DMW-1S – Pyrite precipitation starts immediately. Magnesite, calcite, and rhodochrosite precipitation start at ~ pH 8.8.
- DMW-2S – Pyrite precipitation starts immediately. Brucite, calcite, and rhodochrosite precipitation start at ~ pH 10.0.
- DMW-1D – Pyrite precipitation starts immediately. Brucite, calcite, rhodochrosite, and Mn(OH)₂ precipitation start at ~ pH 10.2.

Table 5.8. Analysis of Aquifer Soils Collected from Three Wells Installed During Site Characterization

Parameter	Method	Units	Sample Location and Depth					
			DP-08-SS 20'	DP-08-SS 20'10"	DP-08-SS 21'3"	DP-09-SS 19'6"	DP-09-SS 20'4"	DP-09-SS 20'8"
pH	EPA SW-846 9045D	SU	4.3	4.4	4.5	4.4	4.5	4.4
% Solids	SM2540B	%	88.6	74.5	76.6	87.6	74.8	76.9
Chloride	EPA SW-846 9056A	mg/kg	2.32	5.09	5.79	4.59	6.11	6.75
Sulfate	EPA SW-846 9056A	mg/kg	57.8	86.6	73.1	61.8	82.9	87.2
Nitrate as N	EPA SW-846 9056A	mg/kg	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U
Nitrite as N	EPA SW-846 9056A	mg/kg	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U
Phosphate as P, ortho	EPA SW-846 9056A	mg/kg	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U	<(0.4)U
Carbonate as CaCO ₃ *	SM2320B	mg/kg	<(2)U	<(2)U	<(2)U	<(2)U	<(2)U	<(2)U
Total Carbon	EPA SW-846 9060	mg/kg	1270	24400	16300	2820	16300	11700
Total Organic Carbon (TOC)	EPA SW-846 9060	mg/kg	739	26200	13000	3540	16600	12900
Total Inorganic Carbon**	EPA SW-846 9060	mg/kg	531	<186 (U)	3300	<182(U)	<480(U)	<154(U)
Cation Exchange Capacity (CEC)	Procedure 8-4.3 (Page, 1982)	mEq/100g	10.6	19.7	17.3	13.9	21.7	14.3
Total Fe	EPA SW-846 3050B	wt %	0.29	1.6	1.26	0.13	1.43	1.52
Fe(II)	EPA SW-846 6010C	wt %	0.12	1.26	0.95	0.04	0.57	0.65
Fe(III)	Procedure 17-3.2 (Page, 1982)	wt %	0.18	0.34	0.31	0.09	0.86	0.88
Trichloroethylene	EPA SW-846 5035B/8260	µg/kg	1560	52200	36700	918	26700	23900
Chloromethane	EPA SW-846 5035B/8260	µg/kg	149 (J)	115 (J)	123 (J)	115 (J)	97.5(J)	<1066
Minerals			Quartz Biotite (Ferrian) Pyrite Goethite	Quartz Phlogopite Lepidolite Pyrite	Quartz Wollastonite Phlogopite Lepidocrocite Pyrite Wustite	Quartz Arsenopyrite Goethite	Quartz Pyrite Lepidocrocite Siderophyllite Goethite Arsenopyrite	Quartz Siderophyllite Cuprite Cubanite Pyrite

*Carbonate alkalinity could not be determined because pH of sample was < 4.5.

**Total inorganic carbon was determined by subtraction of TOC from total carbon

(U), Compound not detected above the indicated PQL.

(J), Estimated value above the calculated MDL and less than the method PQL.

Precipitation was predicted by the model to start at a lower pH with DMW-1S (i.e., shallow zone) because of the relatively higher alkalinity in this composition. However, as discussed in **Section 5.2.4**, the high alkalinity (82.8 mg/L) measured in DMW-1S groundwater is significantly higher than other samples collected at the site, and it is suspected that the bentonite seal or cement/bentonite grout came into contact with the well screen interval during the construction of this well, thus leading to an increase in pH and alkalinity of groundwater samples collected at this well. Additionally, precipitation of calcite in the model was probably overestimated because calcium concentrations in all three samples were non-detectable, so a surrogate concentration equal to the reporting limit of 2 mg/L was assumed in the simulations. Lower calcium concentrations would put off calcite precipitation until pH conditions higher than the values shown above are established. Magnesium and manganese concentrations were detectable, so magnesite, brucite, and rhodochrosite were predicted to become oversaturated at the pH values listed above. The graphs presented below (**Figure 5.5**) show the onset and cumulative precipitation of each mineral (in cm³) as a function of pH, on a per-liter of groundwater basis. These results suggested that attempts should be made to maintain the pH of water leaving the cathode well at pH <9 to minimize precipitation.

Even if precipitation did occur in the JB MDL aquifer, however, the modeling showed that the volume of precipitates would be fairly low because the Ca, Mg, and Mn concentrations in the groundwaters are low. For higher permeability zones of the aquifer, reasonable amounts of precipitation could occur without a significant decrease in permeability. However, for areas of the formation that had low permeability, a small amount of precipitation could have a greater effect on reducing the permeability. The precipitation of pyrite (or other iron sulfides) would be favorable for the abiotic degradation of the cVOCs, but the precipitation of carbonate and hydroxide minerals would reduce the formation porosity and provide no benefit. Based on these results, we attempted to operate the proton reduction system so that groundwater within the cathode well remained at pH <9. This was controlled by adjusting the current to the cathode.

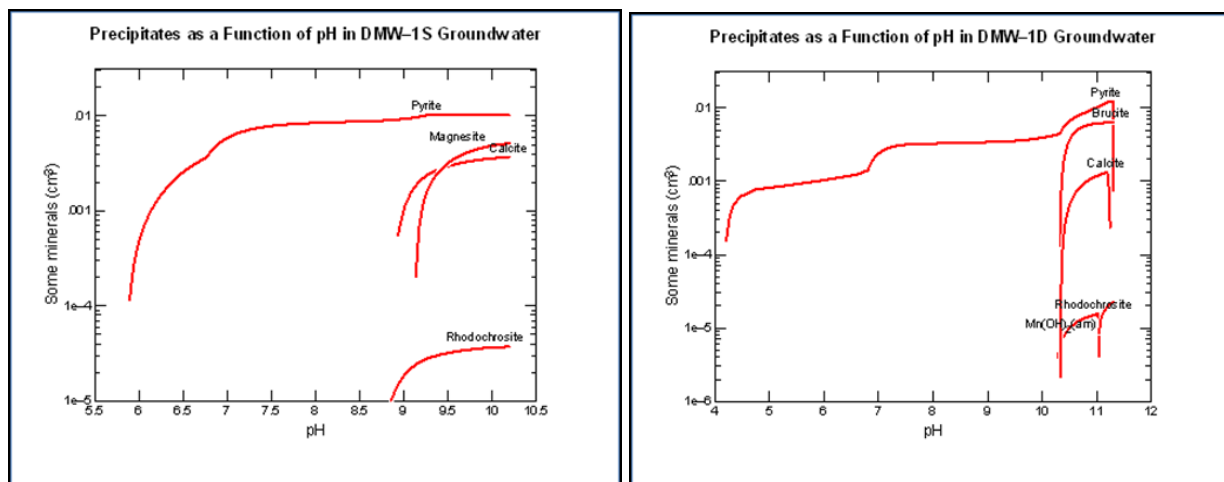


Figure 5.5. Examples of Geochemical Modeling Performed to Evaluate Potential Mineral Precipitation

5.3 TREATABILITY AND LABORATORY STUDY RESULTS

5.3.1 Buffer Testing

Laboratory studies were performed to analyze the aquifer soils and groundwater to evaluate the amount of H^+ consumption or base addition required to adjust the aquifer pH and then maintain it at circumneutral. These data were then used to estimate the potential impact of proton reduction technology on the aquifer pH, and to estimate the amount of time that would be required to increase the pH of the aquifer downgradient of the proton reduction system cathodes (location of proton reduction and OH^- production).

Buffering tests were conducted using groundwater alone as well as groundwater-soil slurries in closed bottles to avoid changes of pH due to loss of carbon dioxide gas. Samples of groundwater were added to 125 mL bottles, and the bottles were immediately closed with a rubber septa and plastic cap that had a hole for insertion of a pH probe. Buffering capacity tests were performed by titration. For soil and sediment slurries, samples of soil and groundwater at a soil:water ratio of 1:6 (w/w) were added to 250 mL glass bottles. The bottles were closed and slurry was mixed and stored at 15°C for three weeks to allow equilibration of the slurry. The neutralizing agents (i.e., titrants), including NaOH, $NaHCO_3$ and $KHCO_3$ at 2, 8, and 20%, respectively, were used as the titrants and added stepwise to bottles containing groundwater or slurry using a syringe and needle inserted through the septa. The samples were titrated with continuous mixing to the required pH value. The buffering demand per liter of groundwater expressed either as equivalents of OH^- or as the amount of required buffering agent to reach the required pH value was determined. The soil buffering demand per kg of dry soil was calculated by subtracting the groundwater demand from the slurry demand. Soil samples were also analyzed for soil moisture and calculation of the dry weight to further aid in calculating buffering capacity.

Results of representative groundwater and soil titrations are shown in **Figures 5.6** and **5.7**. Some variability was identified between samples, and even in triplicate samples from the same location (**Figure 5.7**, left graph), especially if there was a difference in turbidity. Samples with trace amounts of suspended soils (i.e., turbidity) had measurably greater acidity. The addition of soil to the groundwater to create a slurry reduced the initial pH of the sample by approximately one pH unit, and required greater base addition to neutralize the pH. Testing results indicated that approximately 16-24 mM bicarbonate was required to adjust the pH in the aquifer to 6.5 SUs.

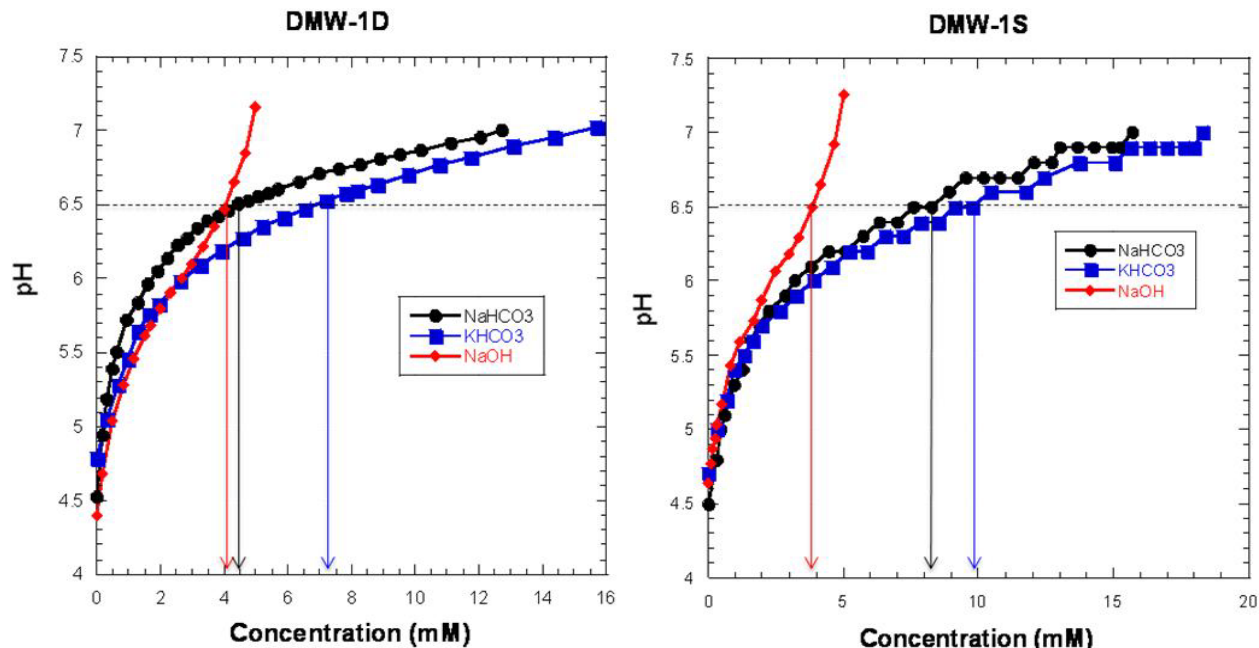


Figure 5.6. Analysis of Buffering Capacity of Groundwater Collected from Two Demonstration Area Wells at JB MDL.

The results demonstrate that approximately 4 mM of OH^- was required to increase the groundwater pH to 6.5. This experiment did not take into account the impact of site soil in pH buffering.

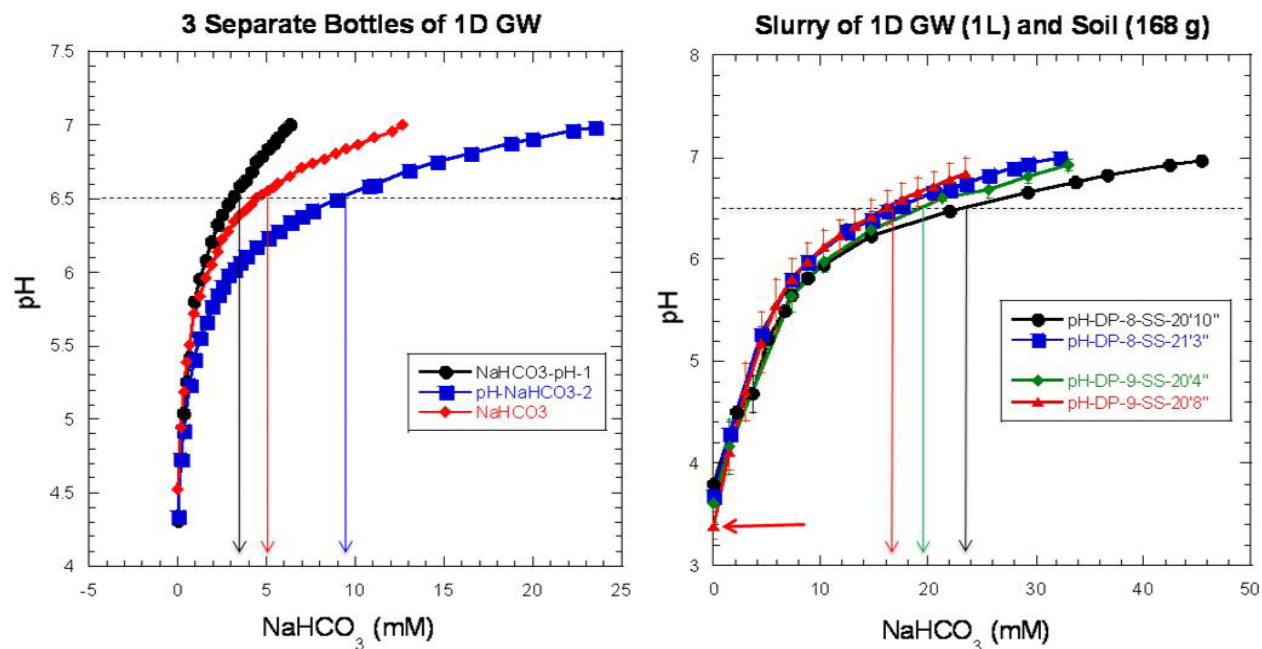


Figure 5.7. Analysis of Buffering Capacity of JB MDL Aquifer Samples.

The left graph shows the results of titrating triplicate samples of groundwater collected from well DMW-1D with sodium bicarbonate. The graph on the right shows the results of a similar titration where 168 g of site soil collected from different depth intervals was added to the same groundwater.

5.3.2 Treatability Testing

A laboratory treatability test was performed with anaerobic soil and groundwater samples collected during site characterization activities (**Section 5.2.1**). The objective of the treatability testing was to demonstrate that the contaminants can be degraded under site, or modified site, conditions, and to evaluate the need to augment the site with an exogenous cVOC-degrading culture. The study involved a serum vial (i.e., microcosm) test that compared dehalogenation under ambient and circumneutral pH. Microcosms were constructed from site soil and groundwater. pH adjustment was performed by adding potassium carbonate. The study evaluated dehalogenation, homoacetogenesis, methanogenesis, and H₂ consumption, and also compared the activity of indigenous microbes to the indigenous population supplemented with a bioaugmentation culture. The microcosms were fed H₂ to mimic the use of cathodic hydrogen. Previous attempts to mimic electrolytic H₂ production in laboratory systems have proved challenging because of electrolytic destruction of VOCs by the electrodes even in poisoned control microcosms. pH adjustment by electrolysis and PR was performed during electrode testing (**Section 5.3.4**).

5.3.2.1 Treatability Study Methods

Soil Preparation. Cores were stored at 4°C until study set up. At the time of set up, cores were placed in a Coy anaerobic chamber with a 100% nitrogen gas headspace. Inside the chamber the end caps were removed from each core. Two slits were then cut down the length of each core on opposite sides, and the core was opened by removing one piece of the acetate sleeve. Soil was separated into three categories: medium-coarse sand, clay/fine sand above the medium-coarse sand, and clay/fine sand below the medium-coarse sand. The sand from each category was homogenized manually using a modified cone and quarter technique.

Microcosm Setup. Soil used for treatability testing consisted of a 50/50 mixture of medium-coarse sand and clay/fine sand from below the medium-coarse sand layer. Twenty grams of this soil mixture was placed anaerobically into each of 40 serum bottles (total volume = 160 mL). Amendments were added as detailed in **Table 5.9**. Eight different treatments were prepared. Site groundwater was added to fill the bottles completely, assuring that no headspace was present. One mL of groundwater was then removed from each bottle to yield a 1 mL headspace. Microcosms were sealed with Teflon-lined butyl rubber stoppers and aluminum crimp seals, and were placed on their sides with gentle shaking at 14°C.

Microcosm Sampling. Microcosms were removed from the shaker and placed upright in the anaerobic chamber. The bottle contents were given sufficient time to settle, usually 30 min., prior to sampling. To sample, the crimp seal was removed from triplicate bottles. The septa were then briefly removed, and groundwater samples were removed and pipetted into glass vials preserved with hydrochloric acid for VOC, reduced gas, and hydrogen analysis. Glass beads were added to the bottle to replace the liquid volume removed, i.e., to keep the bottles consistently at 1 mL headspace. Samples from a fourth bottle were removed in the same manner and immediately analyzed for pH and ORP via a probe and meter. A 5 mL sample was filter sterilized by passing through a 0.2 µm nylon syringe filter and analyzed for volatile fatty acids (VFAs) and anions. Bottles were sampled weekly for the first five weeks of incubation, and at selected timepoints thereafter.

Table 5.9. Treatments Evaluated During Microcosm Testing

	Treatment	Additions	Evaluation
1	Hydrogen gas	H ₂	Dehalogenation and methanogenesis by native bacteria
2	Killed control	H ₂ , formaldehyde (1%)	Abiotic losses
3	Bioaugmentation + pH adjustment	SDC-9 (final OD ₆₆₀ = 0.01), carbonate (to achieve pH ~6.7), H ₂	Dehalogenation and methanogenesis with pH adjustment and bioaugmentation
4	Hydrogen gas + pH adjustment	carbonate, H ₂	Acetogenesis, methanogenesis and dehalogenation by native bacteria
5	Bioaugmentation + H ₂ + acetate + pH adjustment	SDC-9, carbonate, H ₂ , acetate (1000 mg/L)	Need for acetate addition for DHC growth
6	Bioaugmentation + lactate + pH adjustment	SDC-9, carbonate, lactate (1000 mg/L)	Carbon source vs. H ₂
7	No VOCs	SDC-9, carbonate, H ₂ . VOCs were removed from the groundwater used for this treatment by sparging the water with nitrogen gas for 30 minutes	Acetate and methane production
8	No Additions (Live Control)	None	Changes in natural population

5.3.2.2 Treatability Study Results

Results of the treatability study are summarized in **Figures 5.8 to 5.10**. Microcosm results demonstrated that H₂ addition and pH adjustment can support reductive dehalogenation of TCE in JB MDL aquifer samples provided a bioaugmentation culture is applied. Furthermore, H₂ was able to support the production of acetate needed for growth of dechlorinating bacteria.

TCE was not degraded in microcosms that received no additives, and only a very small amount of *cis*-DCE was produced in microcosms that received only H₂ as an electron donor with no pH adjustment (**Figure 5.8**). Likewise, TCE was not effectively degraded in microcosms that received H₂ as an electron donor and were adjusted to pH 7 (**Figure 5.8**). These results suggest that the indigenous bacteria at the test site were unable to efficiently dechlorinate TCE, even after pH adjustment. We have previously demonstrated that dehalogenation activity of a *Dehalococcoides*-containing culture was almost completely inhibited below pH 5.5 (Vainberg et al. 2009), but existing site data, including the existence of some *cis*-DCE, suggests that some residual dechlorination activity might be expected in the aquifer samples. Lacroix et al. (2014) observed partial dechlorination of PCE to *cis*-DCE, due to the apparent activity of a *Sulfurospirillum* strain in the tested culture, at pH 5. Complete dechlorination in that study, however, was only observed in samples incubated at >pH 6. Thus, although some microbes capable of partial TCE dechlorination likely reside in the JB MDL test site, organisms capable of complete TCE dechlorination are absent or in very low numbers.

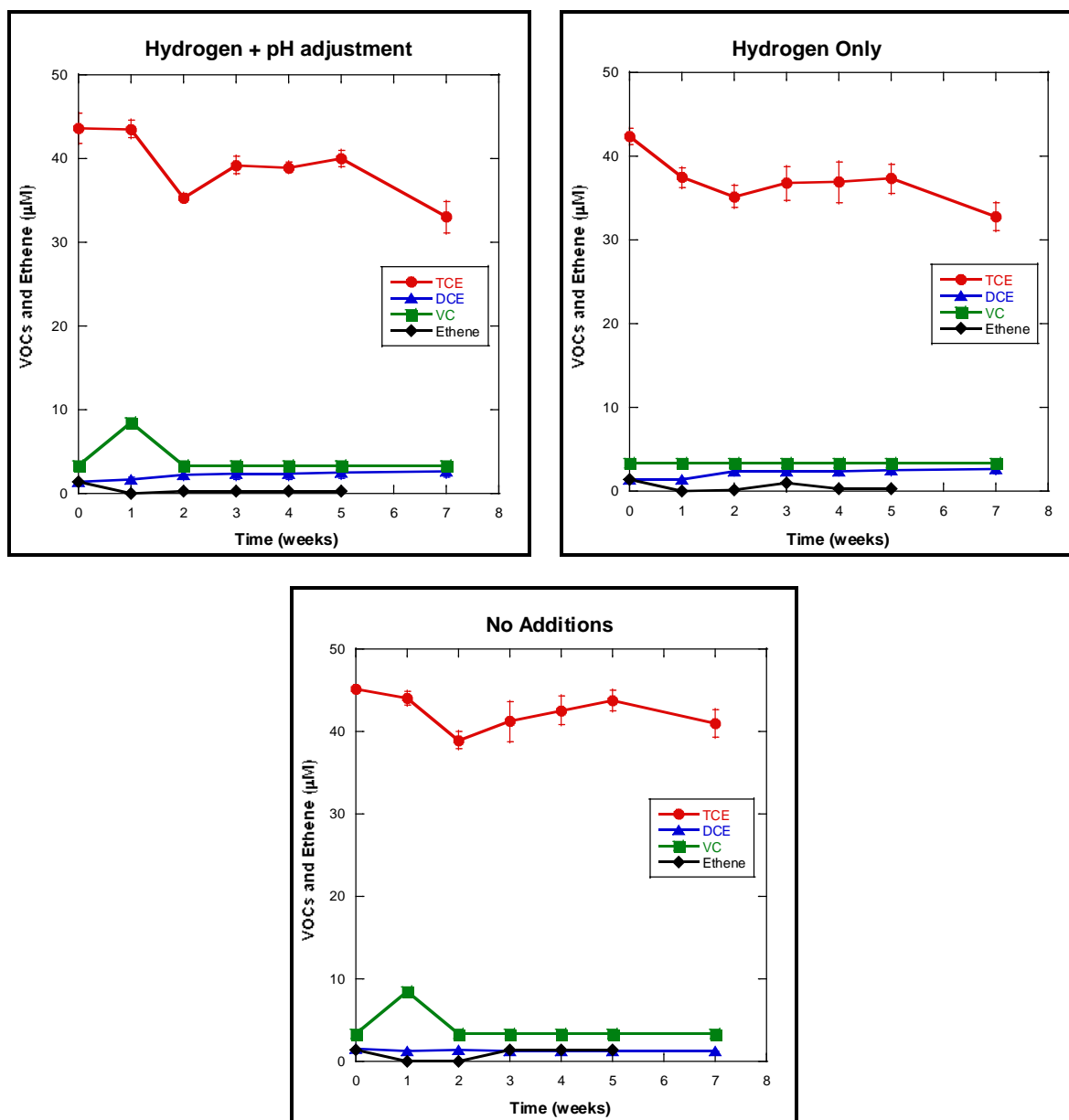


Figure 5.8. Results of Laboratory Treatability Testing at Low pH on Samples from the JB MDL Aquifer.

The results demonstrate that the native microbial population is unable to completely dehalogenate TCE, even with pH adjustment and H₂ addition. Symbols represent the mean of triplicate samples, and error bars represent the standard error.

TCE was dechlorinated to ethene in microcosms that were adjusted to pH 7, bioaugmented with the SDC-9 culture, and fed H₂ as an electron donor (**Figure 5.9**). TCE was rapidly biodegraded to below the method detection limit (MDL) by 4 weeks of incubation in the bottles that received hydrogen gas and SDC-9. The TCE breakdown products cis-DCE, vinyl chloride (VC), and ethene also were generated. Cis-DCE was formed transiently, before also being biodegraded to below the MDL. VC was partially degraded to ethene before degradation ceased.

The fact that ethene was generated indicates that SDC-9 is capable of degrading TCE completely to ethene under site conditions following pH adjustment, although the reason for the decrease in degradation activity near the end of the incubation period is unclear. Possible reasons include nutrient limitations or bottle effects (e.g., buildup of toxic products in the microcosm bottles that would normally be diluted and dispersed in the groundwater of an open system). The addition of a nutrient solution after 6 weeks of incubation appeared to enhance VC dechlorination slightly, and VC dehalogenation in microcosms that received acetate as a carbon source for DHC produced slightly more ethene than bottles that did not receive acetate. This increase in ethene production, however, was probably not directly related to the added acetate because acetate was produced in microcosms augmented with SDC-9 (**Figure 5.10**).

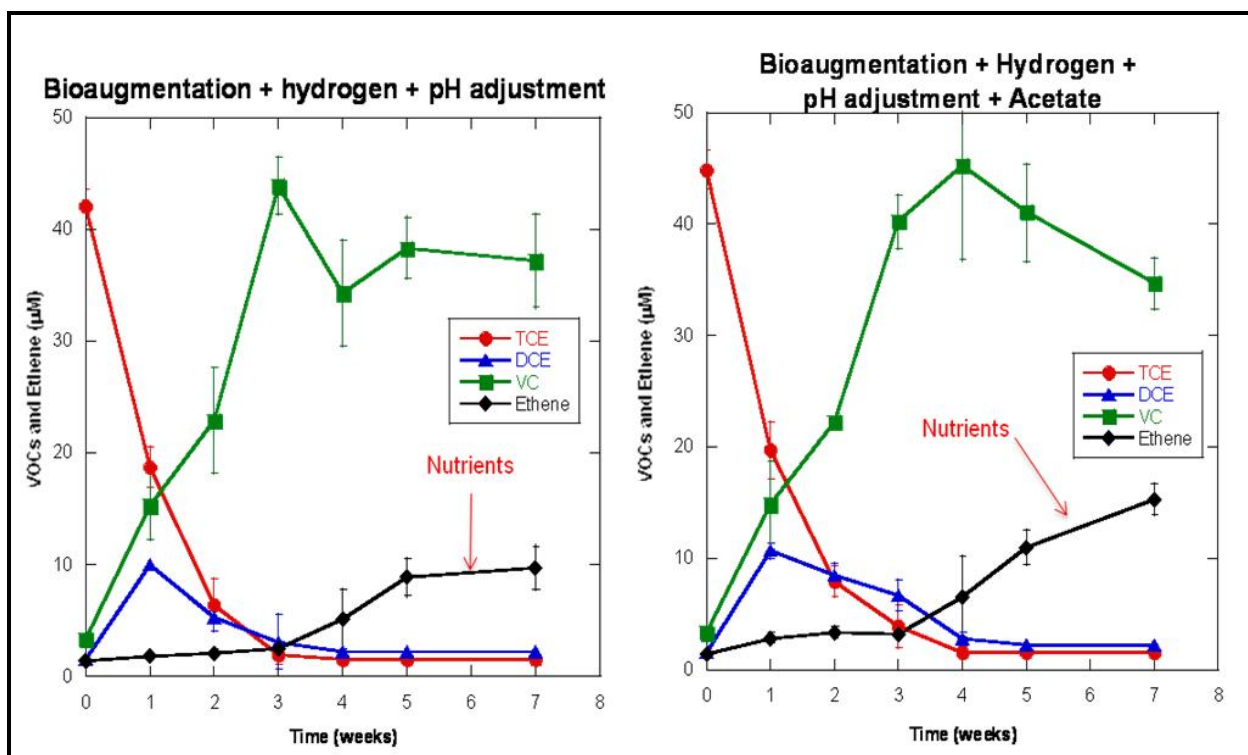


Figure 5.9. Results of Laboratory Treatability Testing at Neutral pH on Samples from the JB MDL Aquifer.

The results demonstrate that complete dehalogenation of TCE to ethene can be achieved with bioaugmentation, pH adjustment, and H₂ addition. The microcosm study was terminated after 7 weeks due to significant depletion of microcosm volume from sampling. Symbols represent the mean of triplicate samples and error bars represent the standard error.

The ability to produce acetate is critical when H₂ is used as a sole electron donor source because acetate is an obligate carbon source for DHC growth (Maymó-Gatell et al., 1997; Löffler et al., 2013). Homoacetogenic bacteria are able to generate acetate during growth on H₂ (Conrad and Wetter, 1990), hence, acetate production also was evaluated during the microcosm tests. Acetate was not generated in microcosms receiving only H₂, with or without pH adjustment (**Figure 5.10**).

Acetate was produced, however, in microcosms that received pH adjustment and the SDC-9 bioaugmentation culture. This suggests that the SDC-9 culture contains homoacetogenic bacteria and that these organisms could be expected to provide acetate to support the growth of DHC *in situ*. The presence of cVOCs in the aquifer samples was not inhibitory to acetate production.

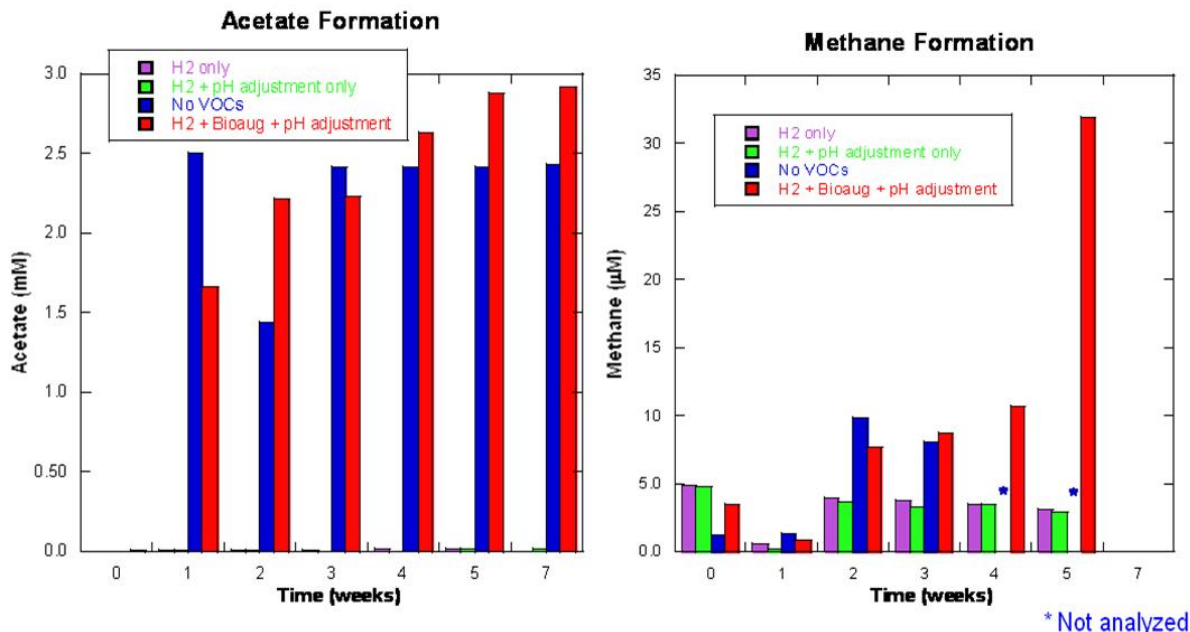


Figure 5.10. Acetate and Methane Formation during Laboratory Treatability Testing on Samples from the JB MDL Aquifer.

Microcosms designated “no VOCs” were identical to the “H₂+ Bioaug.+ pH adjustment” microcosms, except that they were stripped with nitrogen prior to incubation to evaluate the impact of high VOC concentrations in the samples on acetogenesis and methanogenesis. The results demonstrate that acetate can be formed via homoacetogenesis by members of the SDC-9 consortium used for bioaugmentation. Only trace amounts of acetate were produced by the native microbial population.

We also evaluated methane production in the microcosms. Methanogenesis is a redox indicator that can confirm that sufficiently low redox potentials are being achieved to support complete reductive dechlorination of cVOCs. Methanogenesis, however, also can be a sink for H₂ and acetate, and previous studies investigating the injection of H₂ gas into aquifers to support cVOC dechlorination have observed that the consumption of H₂ by methanogens can result in poor hydrogen distribution (Ma et al., 2006) and competition for dehalogenating bacteria, especially if H₂ concentrations *in situ* exceed 100 nM (Ballapragada et al., 1997; Löffler et al., 1999; Yang and McCarty, 1998). During the microcosm study, high concentrations of methane were produced in microcosms augmented with SDC-9, even in the presence of the high cVOC concentrations in the aquifer samples (**Figure 5.10**). These levels of methane production were not unexpected, as the H₂ concentration was at saturation levels due to the presence of H₂ gas in the microcosm headspaces, and because the SDC-9 culture is known to contain methanogenic bacteria (Vainberg et al., 2009).

Overall, the microcosm tests provided several valuable pieces of information to assist in the performance of the field demonstration. They demonstrated that both pH adjustment and bioaugmentation were required to support complete TCE dechlorination under the site conditions present in the JB MDL aquifer. They also demonstrated that the addition of H₂ alone could support complete TCE dechlorination through its use in the production of acetate by homoacetogens in the SDC-9 culture and as an electron donor for reductive dechlorination by DHC. H₂ addition and consumption also supported the generation of sufficiently low redox potentials needed for complete dechlorination as indicated by the production of methane in the microcosms. Importantly, neither TCE dechlorination nor acetogenesis appeared to be inhibited by the high cVOC concentrations present in the aquifer. The microcosm tests also demonstrated that methanogenesis, and presumably competition for H₂ by methanogens, might be expected during the field demonstration, especially if H₂ concentrations become elevated.

5.3.3 2D Flow Cell Testing

In addition to microcosm studies, a simple 2D flow cell was constructed to evaluate cathodic and micro-capacitor proton reduction (**Section 2.1.2**) and to evaluate the transport of cathodic and micro-capacitor H₂ and changes in soil pH (**Figure 5.11**). The flow cell was constructed with Lexan and had dimensions of ~50 cm x 50 cm x 3 cm, with a cover to prevent escape of gases. Plenums were constructed at the influent and effluent ends (bottom and top, respectively) of the cell to generate even distribution of groundwater flow through the cell. The cell was filled with low permeability soils collected from the demonstration site during site characterization activities (**Section 5.2.1**). Two electrodes (0.1" NiTi wire) were installed near the bottom corners of the cell, as shown in **Figure 5.11**. The electrode on the left side of the cell was operated as a cathode, and the electrode on the right side was operated as an anode. Twenty sampling ports were installed throughout the flow cell for collection of H₂, pH, and tracer samples. Five of these sampling ports (D1 through D5) were installed directly between the electrodes to monitor for possible reactions occurring on the soil between the electrodes. Additionally, samples were collected and analyzed for acetylene, an indicator of abiotic degradation of VOCs.

Results of the study are shown in **Figure 5.12**. The cell was operated at 20 V and 4 mA. Calculated H₂ production was 0.15 mg/hr H₂, and calculated OH⁻ production was 1.5 x 10⁻⁴ mg/hr OH⁻. This proton consumption and OH⁻ production resulted in changes in groundwater pH that allowed neutralization of soil and groundwater acidity near and downgradient (upward in the 2-D cell) of the cathode. Likewise, H₂ generated at the cathode was transported downgradient of the cathode, with concentrations as high as 217 µg/L being measured at one of the sample ports downgradient of the cathode. There was no clear evidence that H₂ was being produced at locations in the test cell other than at the cathode. There were periodic detections of low levels of H₂ throughout the cell, but the source of this H₂ is not known.

The amount of current generated in the test cell (4 mA) was considerably lower than was expected in the field (~250 mA) because of the greater electrode surface area in the field and better conductivity in naturally-packed soils. Because the amount of current produced determines the amount of protons that can be reduced, these results suggested that even greater acid consumption and soil neutralization might be expected in the field. Thus, based on the results of this laboratory experiment, we anticipated that we would be able to consume enough acid and produce sufficient base to create a neutralized downgradient treatment area.

The creation of this treatment area *in situ*, however, would still partially rely on the adequate distribution of OH^- from the cathode well, which is dependent primarily on groundwater transport.

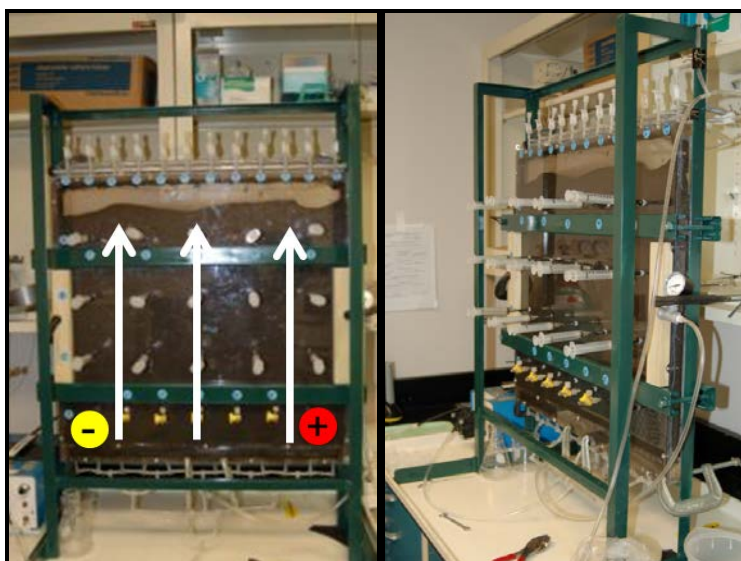
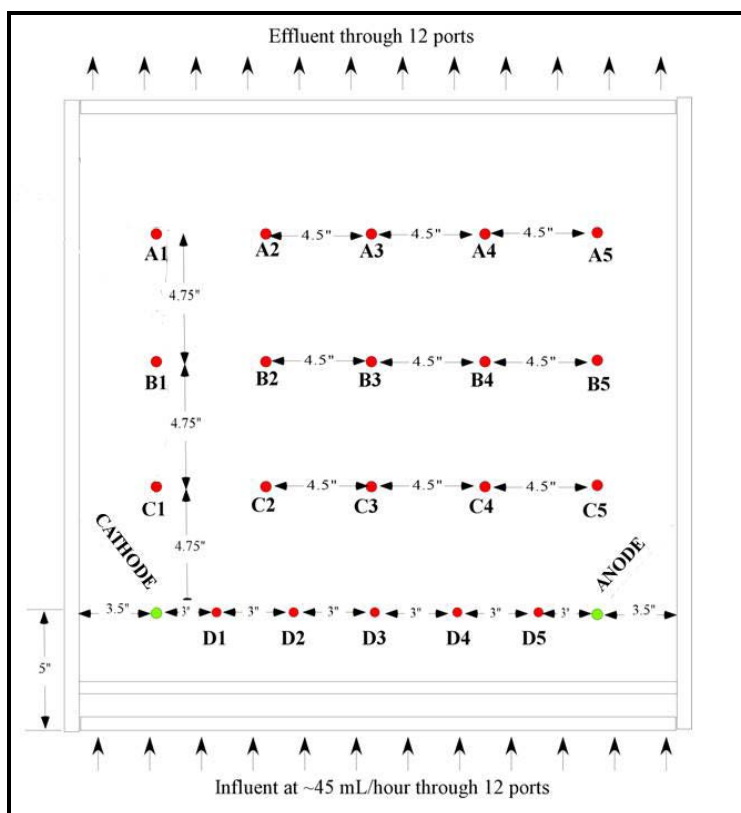


Figure 5.11. Representation and Photos of a 2D Flow Cell to Evaluate Microcapacitor-Generated H_2 .

The cell is filled with aquifer soil from the JB MDL site, and groundwater is being passed through the cell while a current is applied between the electrodes.

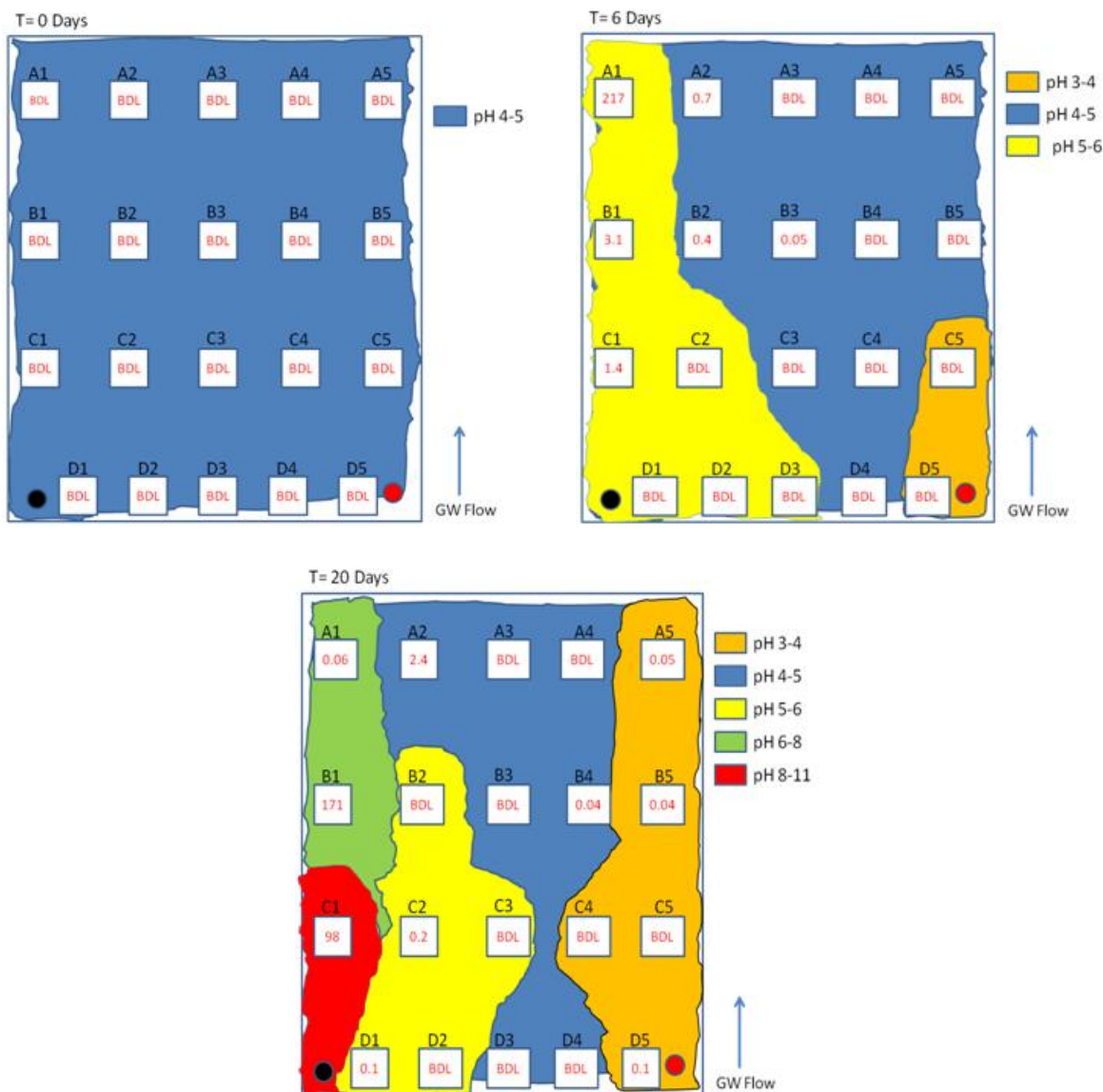


Figure 5.12. Hydrogen Production and pH Changes in the 2D Proton Reduction Flow Cell.

The cell was operated at 20 V and 4 mA. Calculated H_2 production was 0.15 mg/hr H_2 , and calculated OH^- production was 1.5×10^{-4} mg/hr OH^- . Red numbers in the boxes on the figure indicate hydrogen concentration ($\mu\text{g/L}$). The pH contours were drawn by hand.

5.3.4 Electrode Testing

A key component of the PR system is the electrode material used in the subsurface for electrochemical reactions. Previous field scale applications of the proton reduction technology have relied on the use of a variety of electrodes including copper wire, titanium filings, and nickel/titanium wires. Corrosion and failure of the electrodes has been a limitation of the technology, and the most recently used electrodes (0.1 in. NiTi wires) have exhibited failure after 6 to 12 months of operation.

Just prior to the start of this project, Gilbert and co-workers (2008) submitted an addendum to their SERDP final report (CU-0112) in which they report the results of extensive electrode testing. In addition, significant work on cathode development has been performed in recent years for the production of H₂ in microbial fuel cells (c.f., Cheng and Logan, 2007; Selembo et al., 2009). Several electrode options are available, including: 1) carbon steel Geoprobe rods; 2) 0.1" diam. titanium nickel wire as used in in some early CB&I systems; 3) A625 wire as used in microbial fuel cells (Selembo et al., 2009); 4) stainless steel wire/rod; 5) carbon cloth, 6) graphite felt (**Figure 5.13**), 7) steel cable, and 8) mixed metal oxide-coated titanium wire and mesh (MMO electrodes) (**Figure 5.13**).



Figure 5.13. Photographs of Two Tested Electrode Materials.

Top, Elgard 150 mixed metal oxide coated titanium mesh. Bottom, graphite felt.

Carbon steel direct-push rods have an advantage in that they can be easily installed and/or moved between locations, and do not require well installation. However, carbon steel has been shown to corrode faster during use than some other metals. Titanium/nickel and A625 wire resist corrosion and are likely to require less frequent replacement. Stainless steel wire and steel cable are inexpensive, but may need frequent replacement. Gilbert et al. (2008) tested several of these options and concluded that MMO electrodes had many advantages, including cost, that make them well suited for *in situ* applications.

Laboratory testing of several of the materials listed above was performed by CB&I to aid in electrode material selection. The design of tests was incorporated in a treatability study plan submitted to ESTCP. The laboratory tests involved constructing a laboratory test cell for evaluating electrode performance (**Figures 5.14** and **5.15**). The system had 2 electrode chambers connected by an agarose salt bridge. Each electrode chamber was connected to Tedlar bags for capturing gas produced by the electrodes, and ports for collecting the contained water for measuring pH and dissolved gas. The electrodes were connected to a power supply that allowed maintenance of a constant DC voltage or current.

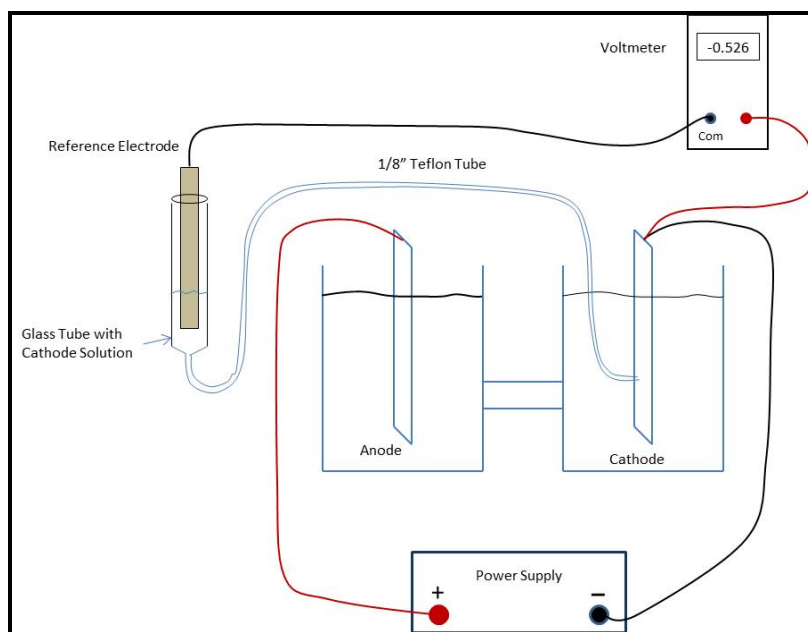


Figure 5.14. Schematic of Test System Used to Evaluate Electrode Performance

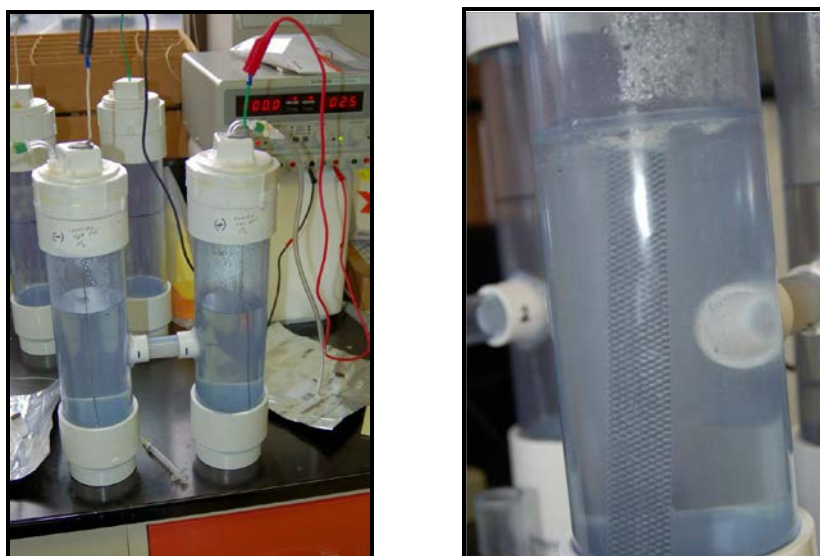


Figure 5.15. Photos of Electrode Test Cell (left) and Close-up of Elgard 150 Electrode during Testing (right)

To test the electrodes, each electrode material was cut into suitable sized pieces, weighed, attached to the electrode lead, and suspended into the electrode chamber. Artificial groundwater was placed in the electrode chambers and the chamber covers with gas collection ports were emplaced. The electrodes were generally operated at 5V DC. Changes in voltage and current were monitored daily, and pH of the ground water was measured at least weekly. H_2 in the cathode chamber collection bag was estimated by removing the gas with a calibrated syringe.

Dissolved H_2 in the water was measured by gas chromatography. The transparency of the electrode chambers (**Figure 5.15**) allowed for monitoring of precipitates/scale forming on the electrode surfaces. After ~60 days of operation, the electrodes were removed, soaked in a weak acid solution to remove scale, dried, and weighed to evaluate % corrosion of the electrodes. Electrodes used for field demonstration would be those that 1) provide sufficient H_2 throughout the tests, 2) exhibit the least corrosion during the test period, and 3) are most cost effective in terms of initial purchase price, expected period of performance, and ease of deployment and replacement.

The two materials that performed the best during testing were the mixed metal oxide-coated titanium (Elgard 150) and the graphite felt. Both of these materials resisted corrosion, provided sufficient H_2 during testing, and exhibited excellent current density at a given potential. While the graphite felt material is most cost effective (~\$1.00/linear ft), it requires manual cutting to the desired width, may not be available in sufficient lengths for field application, and is likely to be harder to install in the field. Additionally, this material was shown during testing to create a “wicking” action which saturated the entire length of the felt above the water column, and lead to corrosion of the wire used to connect to the top of the graphite felt electrode. Therefore, based on the results of the testing (**Figure 5.16**), and prior work by Gilbert and colleagues (2008), it was determined that the Elgard 150 material was most suitable for long term proton reduction field application. The properties and specifications of Elgard 150 are provided in **Appendix C**. The material is also cost effective (~\$2.00/linear ft) and is easy to handle in the field.

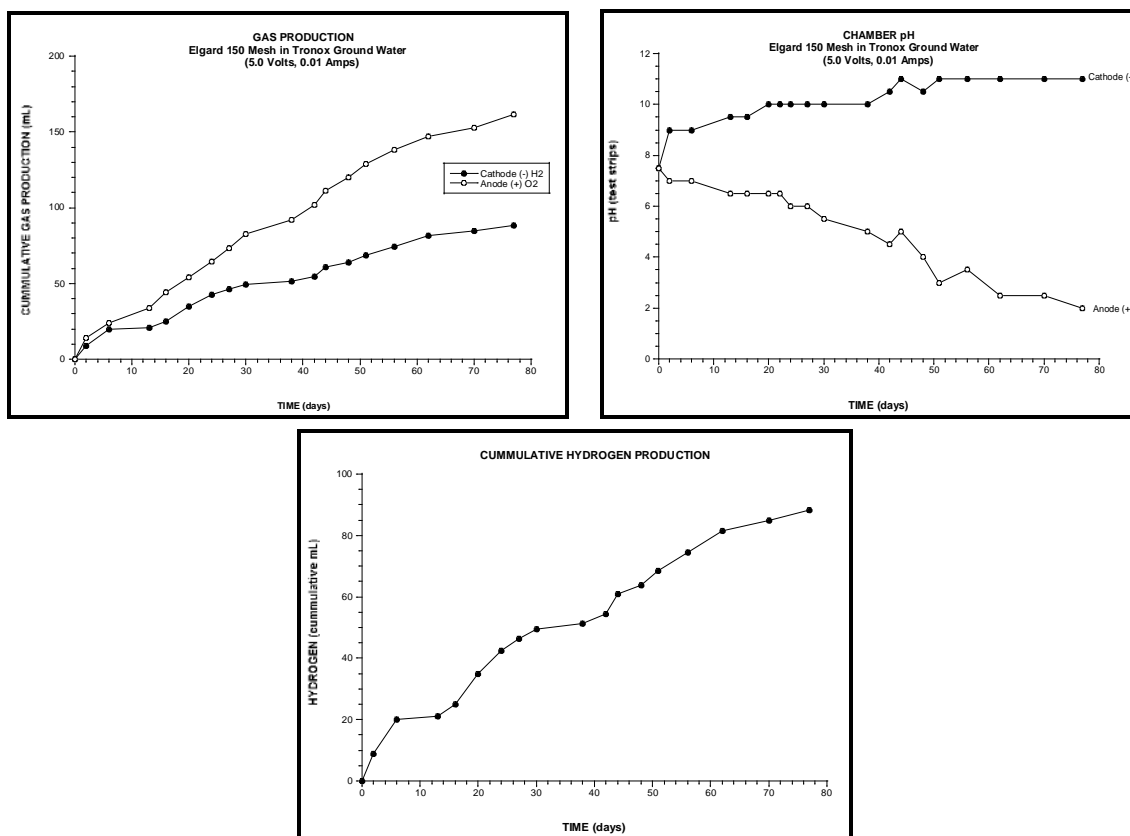


Figure 5.16. Results of Elgard 150 Electrode Material Testing

5.4 DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS

5.4.1 Conceptual Site Model

The Site hydrogeologic and geochemical data collected during site characterization activities (**Section 5.2**) were used to construct the CSM. The CSM indicates that groundwater and dissolved contaminants flow preferentially in an eastern horizontal direction (**Figure 4.2**) through the high permeability medium-coarse sand layer (Layer 2, **Figure 4.3**). Some of these contaminants have diffused (or continue to diffuse) into the underlying silt and very fine sand layer (Layer 3), and the upper portion of the lower permeability clayey silt/sand layer (Layer 4). The direction of vertical diffusion is dependent on the concentration gradient between these layers. However, based on the soil VOC data collected, it is likely that, in addition to upgradient sources, Layer 3 and the upper portion of Layer 4 act as continuing sources of contamination to Layer 2 (i.e., back-diffusion is occurring). Site characterization data indicate that Layer 1 has low levels of contamination, when compared to Layers 2 and 3, and Layer 5 exhibits no contamination in the demonstration area. Therefore, *in situ* treatment during this demonstration focused on Layers 2 and 3. However, the upper portion of Layer 4 was also monitored to determine if H₂ can be distributed or produced within this clayey silt/sand material.

5.4.2 Design Calculations

The amount of electrical current needed to increase aquifer pH and to produce sufficient amounts of H₂ for biological reductive dechlorination of cVOCs was calculated by applying Faraday's law (**Figure 5.17**). Assuming a current of 500 mA, and applying Faraday's Law, the rate of H₂ production at each cathode was calculated to be 9.5 mmol per hour (approximately 0.22 L per hour). This rate of H₂ production was estimated to exceed the molar quantity needed to treat the expected flux of chlorinated ethenes migrating adjacent to the cathode. Yang and McCarty (1998) and Ballapragada and colleagues (1997) have demonstrated that cVOC degrading bacteria have a high affinity for H₂, and that even H₂ concentrations as low as 2 nM can support reductive dechlorination. In addition, this rate of H₂ production is approximately equal to the rate of hydrogen consumption measured in a test aquifer volume of 750 ft³ (5400 gallons) during a hydrogen biosparging test for treatment of PCE (Aziz, 2003). Thus, the H₂ generation rate provided by the cathode was expected to be sufficient to stimulate microbially-enhanced reductive dechlorination of TCE.

The extent to which dissolved H₂ migrates downgradient of the cathode is dependent upon the groundwater velocity and the site-specific H₂ utilization rate. Both of these parameters was estimated (via bench scale testing and measurement of hydraulic gradients/conductivities) prior to final design of an *in situ* system. Based on reported rates of *in situ* dissolved H₂ consumption (0.8 mM H₂ per day) (Ma et al., 2006) and the *in situ* solubility of H₂, H₂ was expected to persist in groundwater (downgradient of the cathode) for approximately 2 to 3 days. If groundwater velocity is slow at a selected site, H₂ will not be distributed far during this period of time. Thus, use of groundwater re-circulation to enhance flow may be required to facilitate the downgradient migration/distribution of dissolved H₂.

The rate of hydroxide production, assuming 500mA and applying Faraday's Law, was calculated to be 19 mmol per hour (**Figure 5.17**). Based on the measured buffering capacity of the groundwater and soils in the target aquifer and the groundwater velocity in the aquifer, the amount of time needed to neutralize a portion of the aquifer downgradient of the cathodes, i.e., the treatment zone, was estimated. Using data obtained from the groundwater modeling and laboratory buffering capacity testing, it was estimated that 8 to 16 weeks of system operation would be required to raise the groundwater pH within a 5-ft zone downgradient of the cathode to greater than pH 6 (assuming a sufficient groundwater flow velocity).

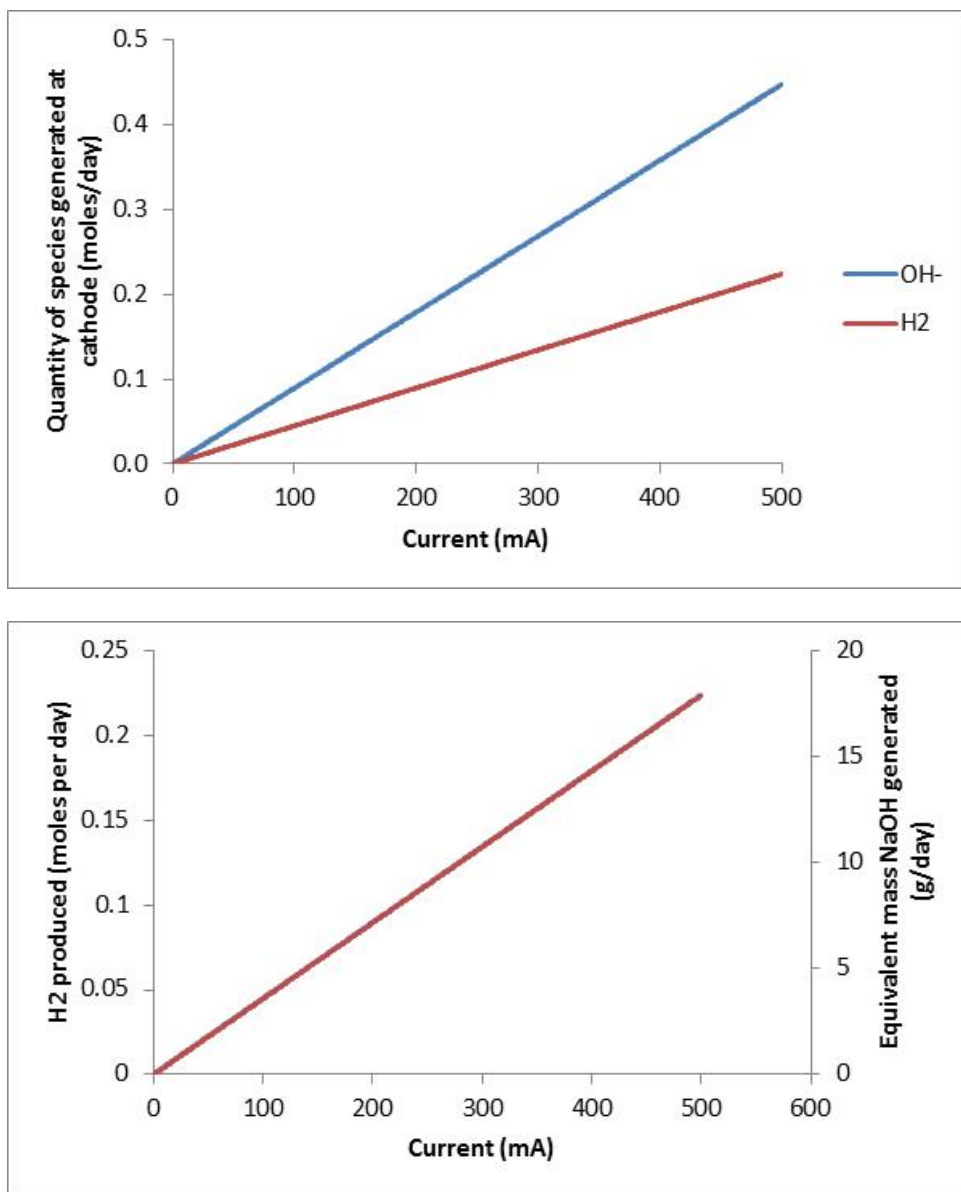


Figure 5.17. Graphs of Calculated H₂ and OH⁻ Production.

Calculated maximum amount of H₂ and OH⁻ that could be produced at the electrode at a given current (top), and the corresponding equivalent amount of NaOH represented by the OH⁻ produced (bottom).

5.4.3 Groundwater Modeling

As discussed in **Section 5.2.3**, the linear groundwater velocity in the demonstration area was estimated between 22 to 80 ft/year. This groundwater velocity was determined to be too slow to effectively evaluate the technology during the planned demonstration period of approximately one year. Therefore, it was decided to increase groundwater velocity by performing groundwater recirculation within the demonstration area. The demonstration test and control plots would be installed inside the groundwater recirculation zone. Groundwater modeling was performed to determine the optimal number of injection and extraction wells, well spacing and screen intervals, and optimal pumping rates.

Preliminary modeling for the conceptual system design was based on a MODFLOW/RT3D simulation using data from the preliminary site characterization. The recirculation model consisted of a six layer model based on the 5 layer site stratigraphy. The top layer was split into 2 layers to improve the model's functionality. The layers are summarized in **Table 5.10**. Model simulations were run with both 1 and 2 extraction and injection wells spaced at 25 and 30 ft apart. The model was run in both steady state or transient mode, and total system extraction and injection rates were varied between 0.5 gpm, 0.75 gpm and 1 gpm. The MODPATH module was used to perform particle tracking and to establish groundwater travel times between the injection and extraction wells.

Preliminary system design includes the following:

- Location and screen intervals for injection and extraction wells
- Injection/extraction well flow rates
- Location of additional monitoring wells
- Location of electrodes.

Table 5.10. Description of Stratigraphic Layers Used to Construct the Demonstration Area Groundwater Model.

Layer	Top of Layer Elevation (ft MSL)	Layer Thickness (ft)	Estimated Hydraulic Conductivity (ft/day)	Geologic Description
1	115	16.8	1	Silty fine sand w sandy/silty clay and silt interbeds
2	98.2	2	1	Silty fine sand w sandy/silty clay and silt interbeds
3	96.2	1.2	5	Medium to coarse sand
4	95	2	0.03	Silt and very fine sand
5	93	7.5	0.003	Clayey silt/sand
6	85.5	5.5	1	Fine sand

Results of the preliminary modeling demonstrated that the use of two extraction and injection wells provided the most even flow across the test plot area and the best ability to capture the test plot groundwater to prevent pushing the treated water away from the test site.

A groundwater extraction rate of 0.5 gpm split between two extraction wells provided better groundwater distribution than using one extraction well. Groundwater travel times between the extraction and injection wells could be varied between 15 and 50 days depending on the groundwater extraction rates and well configuration. Some of the results of the groundwater modeling are presented in **Figure 5.18**.

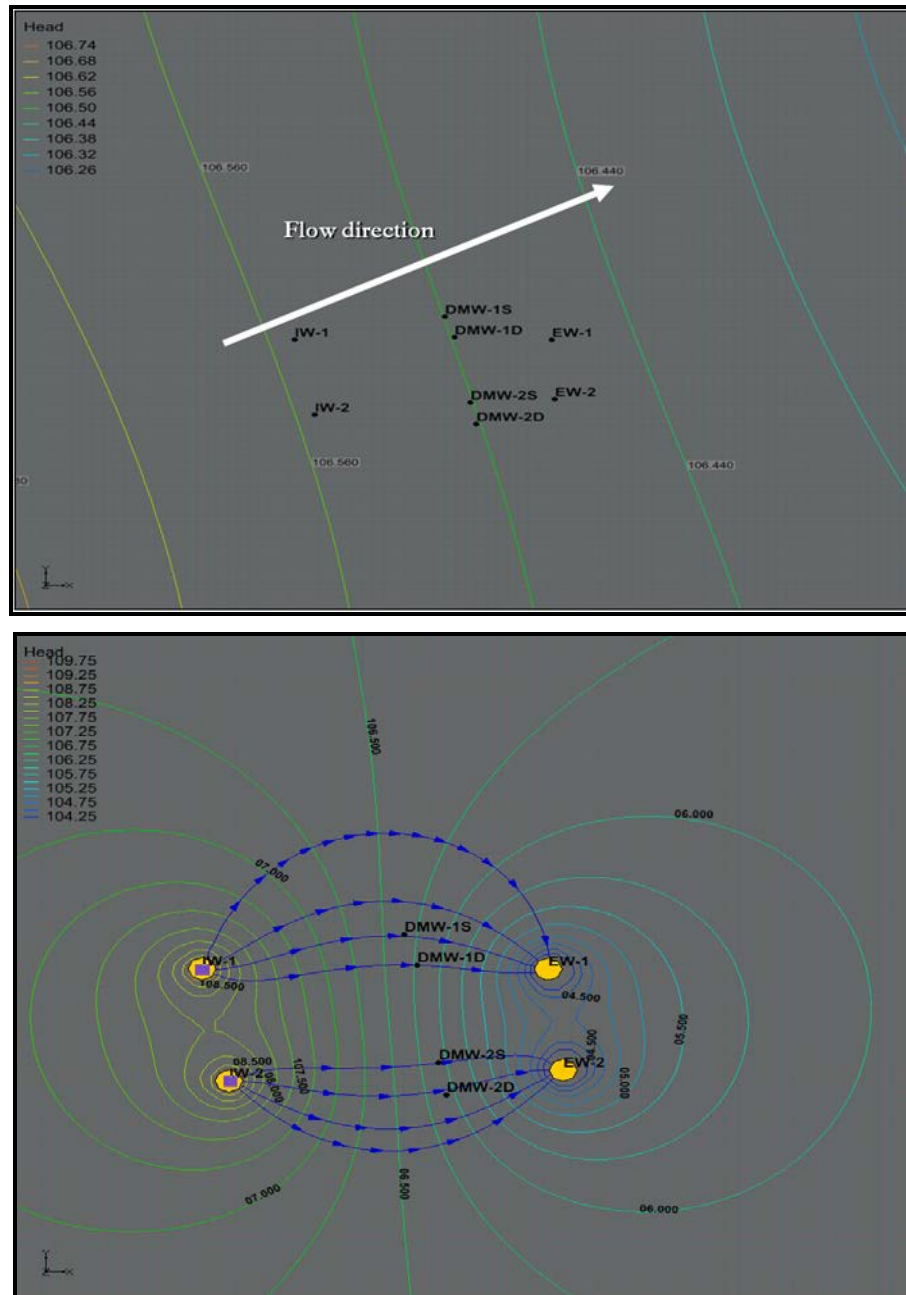


Figure 5.18. Demonstration Site Groundwater Modeling Results.

The top figure represents the site without groundwater recirculation, and the bottom panel shows the results of particle tracking under a flow rate of 0.5 gpm using 2 extraction wells and 2 injection wells spaced 30 ft apart. The distance between the arrows represent ~10 days of travel.

5.4.4 Demonstration Layout

As discussed above, groundwater velocities were determined to be too slow (approximately 2-6 ft per month in the highest permeability layer) to allow for effective short-term monitoring during the course of the demonstration. Therefore, a groundwater recirculation system was installed and operated to force the groundwater gradient through the test plot and control plot, thereby speeding up groundwater velocities and allowing for more effective performance monitoring. Results from the groundwater model were used to determine spacing between extraction and injection wells and an estimated groundwater recirculation rate to achieve a travel time through the plots of approximately 50 days (**Figure 5.18**). Based on CB&I's experience, including bioaugmentation work performed at JB MDL during ESTCP project ER-0515, 50 days of residence time was determined to be more than sufficient for complete dechlorination of TCE to occur.

Two extraction wells (EW-1 and EW-23) and two injection wells (IW-1 and IW-2) were installed as part of a groundwater recirculation system designed to increase groundwater velocity through the demonstration test plot. Additionally, one extraction well (EW-3) and one injection well (IW-3) were also installed to increase groundwater velocity through the demonstration control plot. The test plot and control plot were both the same length, with 30 ft between injection and extraction wells (**Figure 5.19**). However, the test plot was approximately twice the width of the control plot, to allow for additional monitoring locations, and to allow for the monitoring of treatment effectiveness between cathode wells. Submersible pumps were installed in each of the extraction wells, and the extracted groundwater was pumped upgradient to the corresponding injection well (i.e. EW-1 to IW-1) in a closed loop, for a total of three recirculation loops. As discussed in **Section 5.5.3** (System Operation), modifications were made to the system configuration and operation during the demonstration.

Multiple monitoring well screen intervals were selected based on data collected during the site characterization activities discussed above. These intervals are shown in **Figure 5.20**, and include Layers 2 and 3, which contain the bulk of the contaminant mass. Layer 4 was also monitored to determine if hydrogen could be distributed or produced within this clayey silt/sand material, as distribution via groundwater flow is expected to be negligible. Solinst Continuous Multichannel Tubing (CMT) wells were installed at each location, so that two to three discrete zones could be monitored at each horizontal location. As shown on **Figure 5.19**, eleven MLS monitoring wells ("PMW" identifier), constructed with either two or three discrete one-ft screen intervals, were installed for performance monitoring. Additionally, upgradient MLS well BMW-1S/I/D was installed for monitoring untreated groundwater moving into the demonstration area (background well).

As shown on **Figure 5.19**, most of the MLS monitoring wells were spaced at varying distances between the injection and extraction wells (generally 7.5, 15, and/or 22.5 ft downgradient of the injection well). This was intended to provide performance data at varying groundwater travel times from the cathodes. MLS monitoring well PMW-3S/I/D was used to monitor the middle of the test plot to determine if pH adjustment and contaminant reduction was occurring downgradient and between the cathode wells (CW-1 and CW-2). MLS monitoring wells PMW-7S/I/D and PMW-8S/I/D, (spaced 2.5 and 5 ft side-gradient of cathode well CW-2, respectively), were used to determine if H₂ production and pH control was occurring between the cathode and anode wells. MLS monitoring well PMW-9S/I/D was intended to monitor the effects on aquifer geochemistry (particularly pH levels) downgradient of cathode well AW-2.

As exhibited on **Figure 5.19**, the anode and cathode wells were spaced approximately 10 ft apart, and perpendicular to groundwater flow. For this demonstration we spaced the electrodes and monitoring wells so that we could collect sufficient biodegradation, pH, and H₂ distribution data during an approximately 50 day flow time through the test plot. The demonstration consisted of a test plot comprised of 2 cathode wells (CW-1 and CW-2) and 2 anode wells (AW-1 and AW-2), and a control plot comprised of 1 cathode well (CW-3) that shared an anode well with one of the test plot anodes (AW-2) (**Figure 5.19**). The anodes were placed approximately 3 ft further to the east (downgradient) of the cathodes to prevent possible influence on a subsurface natural gas line located approximately 50 ft west (upgradient) of the demonstration plots during system operation.

In this system, acid was consumed and OH⁻ was generated at the cathodes, and high pH water would flow from the cathode wells into the test plot. The proton reduction approach allows for electrodes to be “turned down” or off in order to reduce acid consumption and OH⁻ generation. Additionally, the polarity of the electrodes can be switched to control spatial variability in pH. That is, the cathodes can temporarily become anodes to produce some acid to prevent very high pH levels. In fact, in our previous field applications of this technology, electrode polarity was changed regularly to control pH swings in the aquifers because adjusting the groundwater pH was not the objective of the treatment, but rather an undesirable consequence. Conceptually, this approach equates to controlling base addition rates. Additionally, with proton reduction, groundwater flow distributes the dissolved H₂ needed for reductive dechlorination. Therefore, like any other enhanced *in situ* anaerobic bioremediation technology, the distribution of the electron donor is controlled by groundwater flow and aquifer geology.

Although the proton reduction system was operated using solar power, it was determined that the groundwater recirculation system would require too much power to operate economically via solar power. Therefore, electrical service was obtained from Building 2304, located adjacent to the demonstration area. As discussed above, the groundwater recirculation system was only used to force the groundwater gradient through the test plot and control plot, because groundwater velocities were determined to be too slow to allow for effective short-term monitoring during the course of the demonstration. It should be noted that a groundwater recirculation system would not be required during full scale (longer term) operation of a proton reduction system.

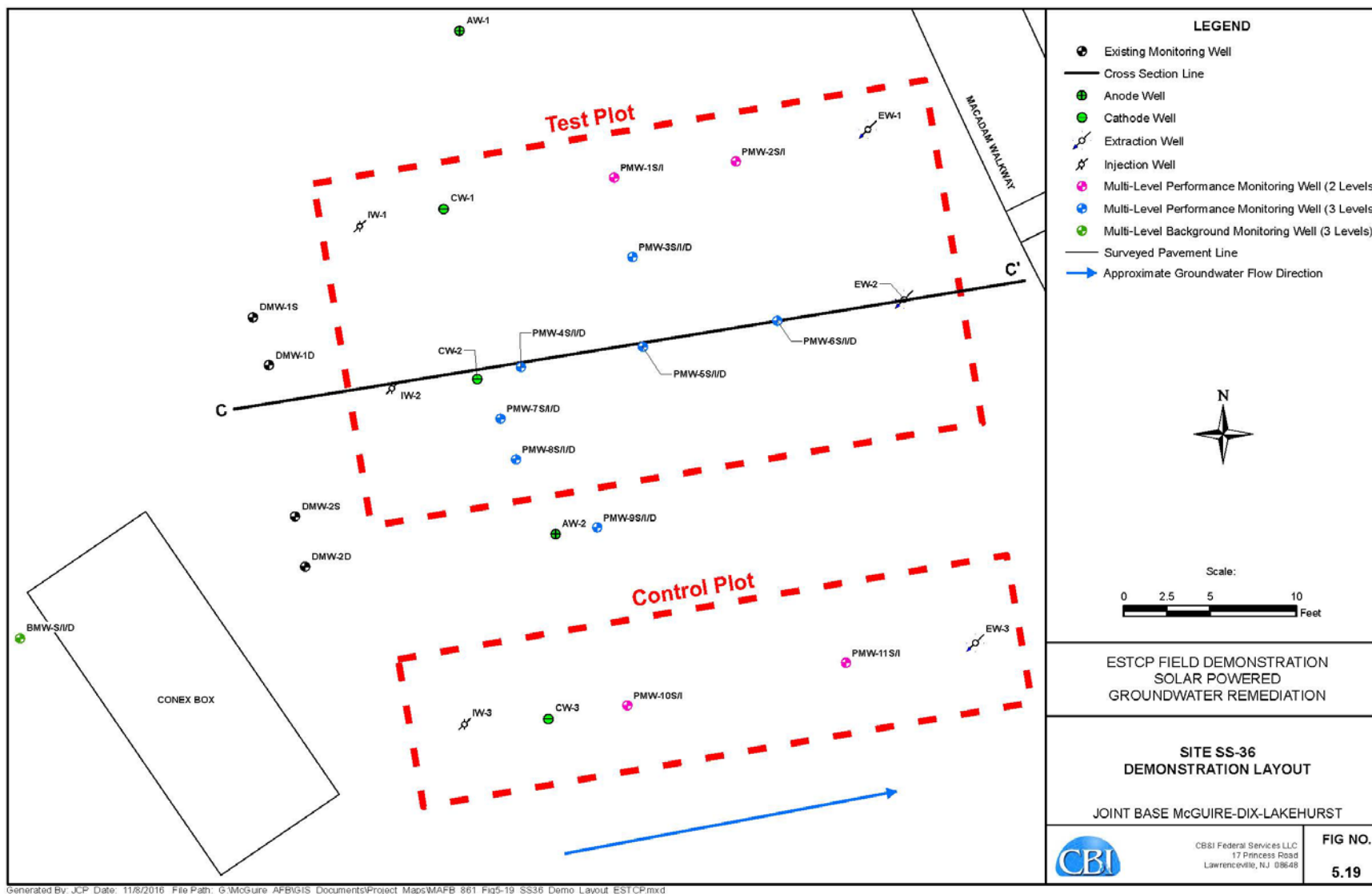


Figure 5.19. Plan View of the Proton Reduction Demonstration Plots in Area SS-36

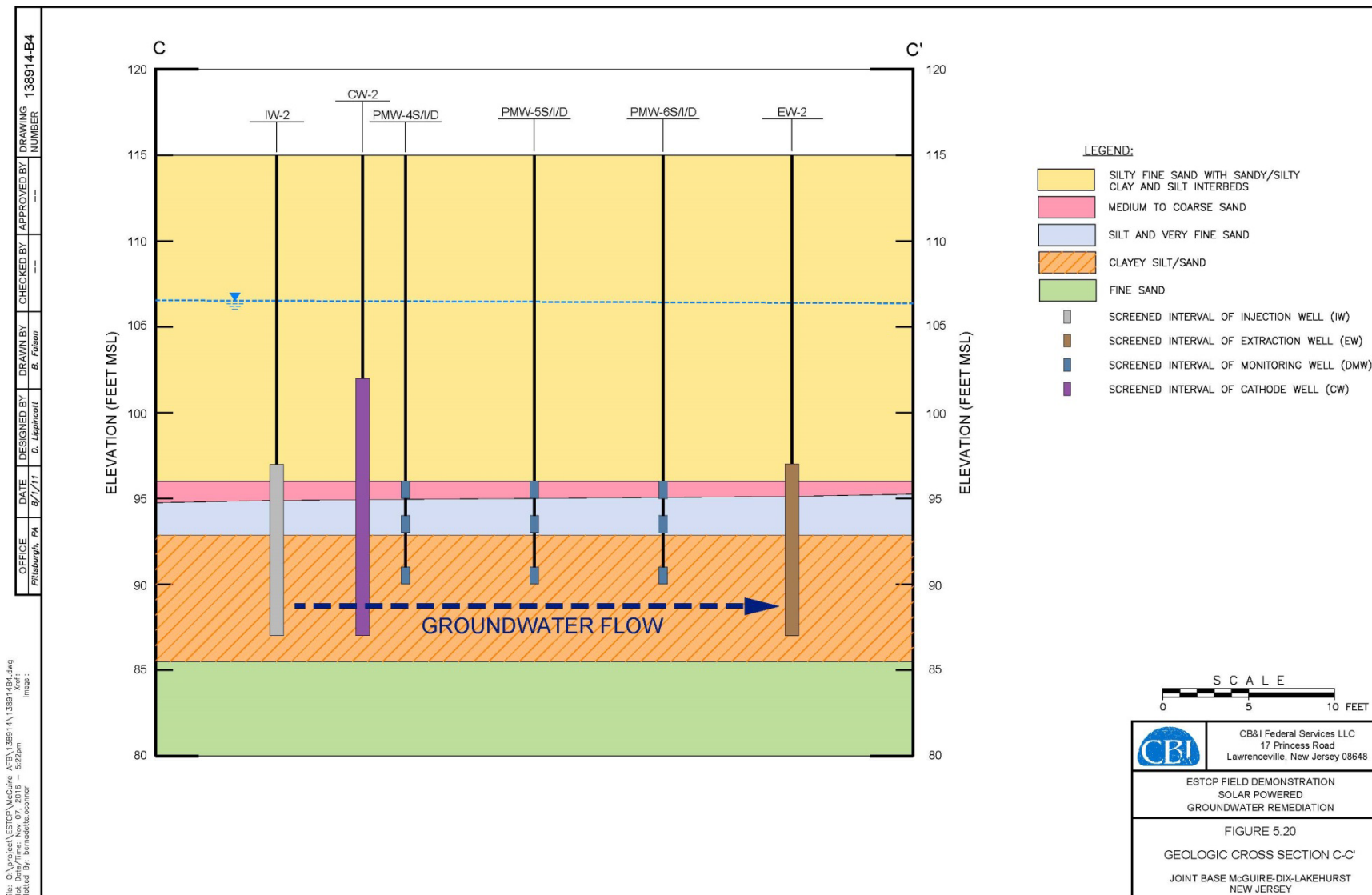


Figure 5.20. Cross Sectional View of the Proton Reduction Demonstration Test Plot

5.4.5 Electrode Installation

The five electrode wells were installed using the Hollow Stem Auger (HSA) drilling method. These wells served as both monitoring wells and electrodes, and were constructed as a typical monitoring well. These wells were constructed with flush-threaded, 2-inch diameter, Schedule 40, PVC riser and 15 ft of 0.010-inch slotted PVC well screen. Wells screen intervals were from approximately 13.5' to 28.5' bgs and transected Layers 1 through 4 (**Figure 5.20**). The filter pack for each well consisted of #1 Morie sand extending to 3.0 ft above the top of screen. The remaining annular space was filled with bentonite chips emplaced to within 2 ft of the surface. A summary of the as-built well construction details are provided in **Table 5.11**.

Based on the work of Gilbert and colleagues (2008) and in our own laboratory (**Section 5.3.4**), the electrodes installed in our field demonstration system were mixed metal oxide coated Elgard mesh electrodes (**Figure 5.21**). The electrodes were cut to length in the field so that they extended from a lead (16 gauge copper wire) near the bottom of the well cap to the bottom of the electrode well. The electrical lead was coiled at the top of the mesh electrode and wrapped with electrical tape to relieve stress on the lead connection, and to prevent loss of the electrode if the lead corroded (**Figure 5.22**). A large, stainless steel nut was attached to the bottom of the electrode to provide weight during installation and to insure that the electrode rested on the bottom of the well. The connection between the lead and the electrode, and any exposed wire, was painted with Plasticoat to prevent exposure to moisture and prevent corrosion of the lead or connection.

The electrode wells were capped with custom made well caps (**Figure 5.22**) that have a pass through for the electrode lead and sampling ports and that allow sampling of groundwater and gasses without removing the cap and electrode. A junction box was installed above the cap to allow safe connection of the electrode lead to the power source. The wells were completed in covered, rectangular plastic flush-mount vaults (**Figure 5.22**).

All well installations were performed by a New Jersey licensed driller and supervised by a CB&I geologist. Upon completion, all wells were thoroughly developed to remove fines. Well installations and development were performed between August 11 and September 16, 2011. All investigation-derived waste (IDW) was containerized and staged in the demonstration area, characterized, and disposed of off-site. Each completed well was surveyed by a licensed surveyor to determine its horizontal location to within ± 1 ft, and the elevation of the top of the inner PVC well casing to a ± 0.01 ft precision.

Table 5.11. Summary of As-Built Electrode, Extraction, and Injection Well Construction Details

WELL ID	GROUND SURFACE ELEVATION (FT MSL)	TOP OF CASING ELEVATION (FT MSL)	WELL DIAMETER (IN)	BOREHOLE DIAMETER (IN)	TOP OF SCREEN (FT BGS)	BOTTOM OF SCREEN (FT BGS)	TOP OF FILTER PACK (FT BGS)	BOTTOM OF FILTER PACK (FT BGS)	TOP OF SEAL (FT BGS)	BOTTOM OF SEAL (FT BGS)
EXTRACTION WELLS										
EW-1	115.49	114.89	4.0	10.0	18.0	28.0	15.0	28.0	3.0	15.0
EW-2	115.37	114.85	4.0	10.0	18.0	28.0	15.0	28.0	3.0	15.0
EW-3	115.49	114.83	4.0	10.0	17.8	27.8	14.5	27.8	3.0	14.5
INJECTION WELLS										
IW-1	115.12	114.54	4.0	10.0	18.2	28.2	15.0	28.2	3.0	15.0
IW-2	115.08	114.70	4.0	10.0	17.8	27.8	14.8	27.8	3.0	14.8
IW-3	114.94	114.31	4.0	10.0	18.3	28.3	15.0	28.3	3.0	15.0
ELECTRODE WELLS										
CW-1	115.28	114.71	2.0	8.0	12.9	27.9	10.0	27.9	2.3	12.9
CW-2	115.08	114.62	2.0	8.0	12.8	27.8	9.5	27.8	2.0	9.5
CW-3	115.09	114.35	2.0	8.0	13.0	28.0	10.0	28.0	2.5	10.0
AW-1	115.55	114.99	2.0	8.0	13.3	28.3	10.0	28.3	2.4	10.0
AW-2	115.03	114.45	2.0	8.0	13.3	28.3	9.5	28.3	2.0	9.5

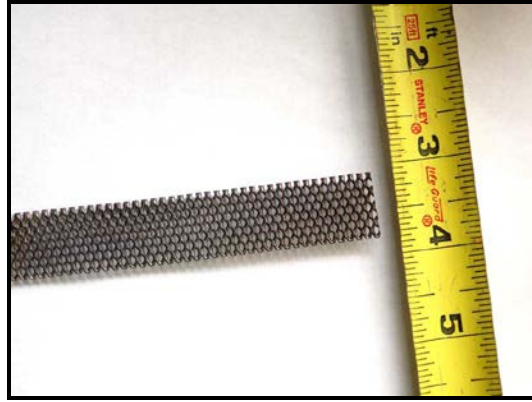


Figure 5.21. Photo of Elgard Mixed Metal Oxide-Coated Titanium Electrode Material.
This material was selected for use in the field demonstration system.



Figure 5.22. Photographs of Wells Heads Designed for Connecting Electrodes.
An external view of well head attached to an electrode monitoring well. B, attachment of the electrode to an electrical lead. Exposed connections were painted with Plasticote to minimize corrosion. C, view of the uncapped well head showing sampling tube and electrode lead extending into the well.

5.4.6 Extraction & Injection Well Installation

The three extraction and three injection wells were installed using the HSA drilling method. These wells were constructed with flush-threaded, 4-inch diameter, Schedule 40, PVC riser and 10 ft of 0.010-inch slotted PVC well screen. Groundwater modeling indicated that the wells should be screened across Layers 2 through 4, and just above Layer 2 (the high permeable layer) of the aquifer to maximize groundwater flow through the contaminated portions of the aquifer. Based on this, well screen intervals were set from approximately 18 ft to 28 ft bgs, as shown on **Figure 5.20**. The filter pack for each well consisted of #1 Morie sand extending to 3.0 ft above the top of screen. The remaining annular space was filled with cement chips emplaced to within 3 ft of the surface. The wells were completed in covered, rectangular plastic flush-mount vaults. A summary of the as-built well construction details are provided in **Table 5.11**.

All well installations were performed by a New Jersey licensed driller and supervised by a CB&I geologist. Upon completion, all wells were thoroughly developed to remove fines. Well installations and development were performed between August 11 and September 16, 2011. All IDW was containerized and staged in the demonstration area, characterized, and disposed of off-site. Each completed well was surveyed by a licensed surveyor to determine its horizontal location to within ± 1 ft, and the elevation of the top of the inner PVC well casing to a ± 0.01 ft precision.

5.4.7 Multi-Level Monitoring Well Installation

As described in **Section 5.4.4**, a total of twelve Solinst CMT wells were installed in the demonstration area. As shown on **Figure 5.19**, eleven performance MLS monitoring wells (“PMW” identifier) were installed within the Test Plot and Control Plot, and one upgradient background MLS monitoring well (BMW-1S/I/D) was installed for monitoring untreated groundwater moving into the test and control plots. These wells were installed using the HSA drilling method, and each well was constructed with either two or three discrete one-ft screen intervals as shown in **Table 5.12**:

Table 5.12. Target Multi-level Monitoring Well Screen Intervals

Interval	Approx. Screen Interval (ft bgs)	Stratigraphic Layer
Shallow	20.0 – 21.0	2 – Medium to coarse Sand
Intermediate	22.5 – 23.5	3 – Silt and very fine Sand
Deep	26.0 – 27.0	4 – Clayey Silt/Sand

Multilevel sampling systems (continuous multichannel tubing, or CMT 403, manufactured by Solinst) were used to screen these 2-3 depths within a single well. The CMT system uses continuous polyethylene multichannel tubing that was custom-built on site with screened intervals at the designated sampling intervals (**Figure 5.23**). The single tube design allows reliable seals between zones. Samples are taken from different zones through each channel using small dedicated tubing and peristaltic pumps.

The filter packs consisted of #1 Morie sand extending to six inches above and below each discrete 1-ft screen interval, for a total of two ft per monitoring interval. One-quarter inch coated bentonite chips were emplaced between filter pack intervals to create a seal between monitoring intervals. An additional six inches of coated bentonite chips were emplaced above the uppermost filter pack, and the remaining annular space was filled with standard 3/8-inch bentonite chips emplaced to within 2 ft of the surface. Each well was completed in covered, round plastic flush-mount vault. A construction diagram for the MLS monitoring wells is provided in **Figure 5.24**, and a summary of the as-built well construction details are provided in **Table 5.13**. All well installations were performed by a New Jersey licensed driller and supervised by a CB&I geologist. Upon completion, all wells were thoroughly developed to remove fines. Well installations and development were performed between August 11 and September 16, 2011. All IDW was containerized and staged in the demonstration area, characterized, and disposed of off-site. Each completed well was surveyed by a licensed surveyor to determine its horizontal location to within ± 1 ft, and the elevation of the top of the inner PVC well casing to a ± 0.01 ft precision.



Figure 5.23. Photos of the Solinst CMT Multi-level Wells Used in the Demonstration.

Top left, slots cut in the wells at the desired depth interval. Bottom left, screens installed over the slots cut in the well channel. Right, completed wells showing the well anchors in the foreground and the screen placement at various depth intervals.

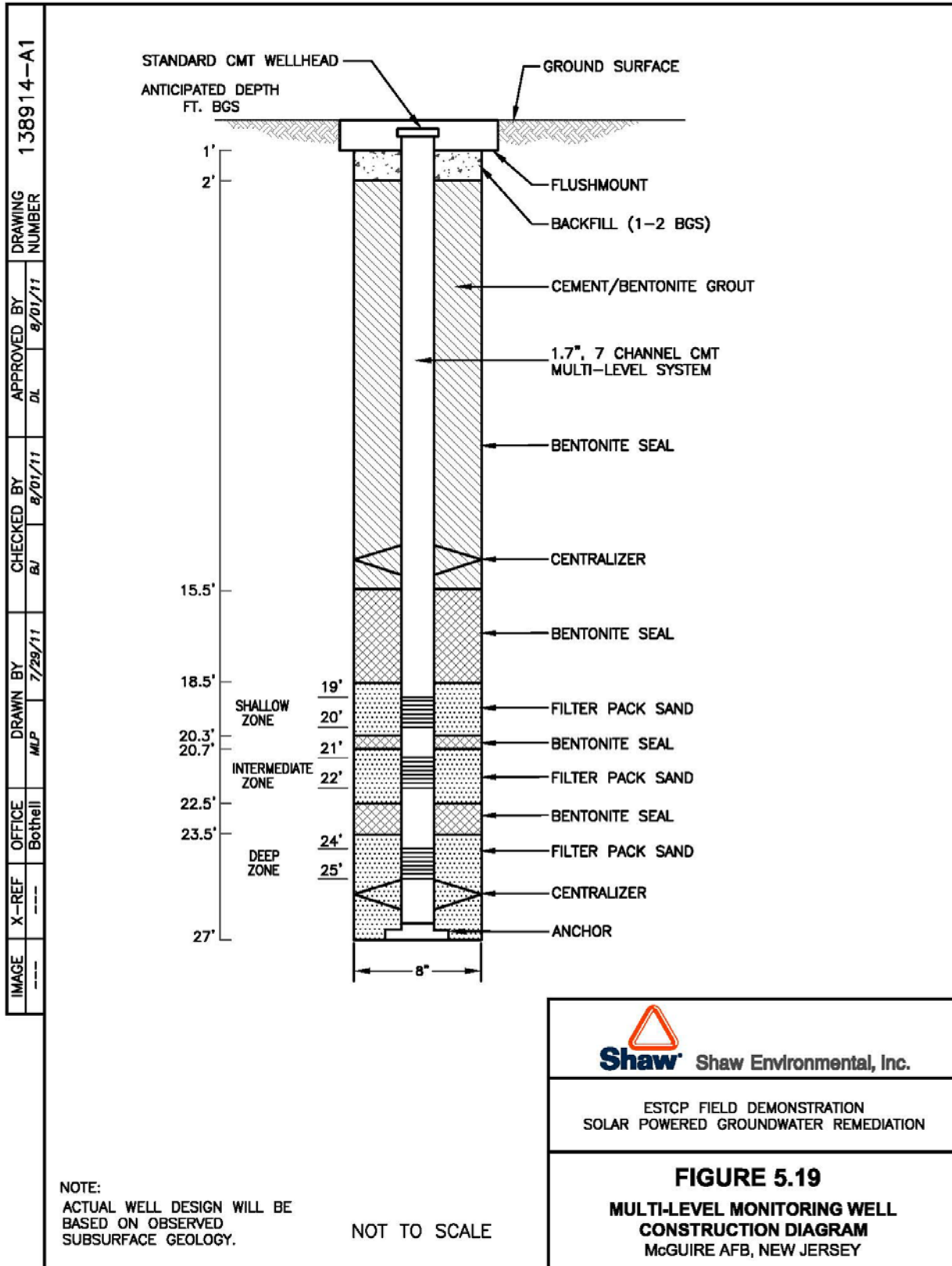


Figure 5.24. Multi-level Monitoring Well Construction Diagram

Table 5.13. Summary of As-Built Multi-Level Monitoring Well Construction Details

Location	Ground Surface Elevation (ft. MSL)	Top of Casing Elevation (ft. MSL)	Total Depth (ft. bgs)	Shallow Screen Interval						Intermediate Screen Interval						Deep Screen Interval					
				Top of Screen (ft bgs)	Bottom of Screen (ft. bgs)	Top of Sand (ft. bgs)	Bottom of Sand (ft. bgs)	Top of Seal (ft. bgs)	Bottom of Seal (ft. bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft. bgs)	Top of Sand (ft. bgs)	Bottom of Sand (ft. bgs)	Top of Seal (ft. bgs)	Bottom of Seal (ft. bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft. bgs)	Top of Sand (ft. bgs)	Bottom of Sand (ft. bgs)	Top of Seal (ft. bgs)	Bottom of Seal (ft. bgs)
BMW-1	115.62	114.78	28.6	20.8	21.8	20.3	22.3	2.8	20.3	23.3	24.3	22.8	24.8	22.3	22.8	26.8	27.8	26.3	28.6	24.8	26.3
PMW-1	115.59	114.71	25.0	20.3	21.3	19.8	21.8	2.2	19.8	22.8	23.8	22.3	25.0	21.8	22.3	NA	NA	NA	NA	NA	NA
PMW-2	115.46	114.74	24.7	20.0	21.0	19.5	21.5	2.0	19.5	22.5	23.5	22.1	24.7	21.5	22.1	NA	NA	NA	NA	NA	NA
PMW-3	115.51	114.62	28.0	20.2	21.2	19.7	21.7	2.2	19.7	22.7	23.7	22.2	24.2	21.7	22.2	26.2	27.2	25.7	28.0	24.2	25.7
PMW-4	115.2	114.43	27.7	19.9	20.9	19.4	21.4	2.3	19.4	22.4	23.4	21.9	23.9	21.4	21.9	25.9	26.9	25.4	27.7	23.9	25.4
PMW-5	115.5	114.71	28.1	20.3	21.3	19.8	21.8	2.3	19.8	22.8	23.8	22.3	24.3	21.8	22.3	26.3	27.3	25.8	28.1	24.3	25.8
PMW-6	115.56	114.9	28.0	20.2	21.2	19.7	21.7	2.2	19.7	22.7	23.7	22.2	24.2	21.7	22.2	26.2	27.2	25.7	28.0	24.2	25.7
PMW-7	115.08	114.08	27.8	20.0	21.0	19.5	21.5	2.5	19.5	22.5	23.5	22.0	24.0	21.5	22.0	26.0	27.0	25.5	27.8	24.0	25.5
PMW-8	114.96	114.3	27.3	19.5	20.5	19.0	21.0	2.1	19.0	22.0	23.0	21.5	23.5	21.0	21.5	25.5	26.5	25.0	27.3	23.5	25.0
PMW-9	115.07	114.4	27.4	19.6	20.6	19.1	21.1	2.2	19.1	22.1	23.1	21.6	23.6	21.1	21.6	25.6	26.6	25.1	27.4	23.6	25.1
PMW-10	114.99	113.65	24.9	20.2	21.2	19.7	21.7	2.8	19.7	22.7	23.7	22.2	24.9	21.7	22.2	NA	NA	NA	NA	NA	NA
PMW-11	115.51	114.76	24.9	20.2	21.2	19.7	21.7	2.3	19.7	22.7	23.7	22.2	24.9	21.7	22.2	NA	NA	NA	NA	NA	NA

5.4.8 Groundwater Recirculation System

The majority of the groundwater recirculation and system was installed during the weeks of October 11 and October 18, 2011. The groundwater recirculation system was constructed within a 20-ft long Conex box, located within the demonstration area (**Figure 5.19**) during the weeks of October 11 and October 18, 2011. Photographs of the Conex box and system are provided in **Figure 5.25**. A process flow diagram (PFD) showing the general design of the system, including extraction and injection wells and the associated equipment, is provided in **Figure 5.26**.

Submersible variable-speed pumps set in the center of the well screens were installed in each of the extraction wells to extract groundwater from the aquifer. Three-ft deep trenches were excavated from each of the extraction and injection wells to the 20-ft Conex box. Piping and conduit were connected to each of the wells, installed within the trenches, and passed through the bottom of the Conex box (**Figure 5.27**). Electrical conduits were installed within the trenches for pump power supply wires, level control probe wires for the extraction wells, and pressure transducers cables for the injection wells. Valves, gauges, and fittings were installed as necessary to complete the piping runs and connections. The trenches were backfilled after leak testing was performed on the piping and all wires and cables were successfully installed.

As discussed above, although the proton reduction system was operated using solar power, it was determined that the groundwater recirculation system would require too much power to operate economically via solar power. Therefore, electrical service was obtained from Building 2304, located adjacent to the demonstration area. CB&I coordinated installation of single-phase, 240 volt, 80 amp electrical service and a wireless connection to the 20-ft Conex box. CB&I subcontracted Calcon Systems, Inc. to update a process controls system within the Conex box (the Conex box and controls system were used during previous bioremediation projects). The controls system consisted of a Programmable Logic Controller (PLC) panel connected to a desktop computer, and a Supervisory Control and Data Acquisition (SCADA) system (**Figure 5.26**). The PLC panel was connected to flow meters/totalizers and level control probes within the extraction wells, and pressure transducers within the injection wells. The SCADA system collected data from various sensors and sent the data to the computer for recording and storage. The SCADA system with wireless communication allowed for remote real-time monitoring and control of the system operating conditions. Parameters measured and recorded during operation included extraction well pump run times, flow rates, and speed, and water levels within the injection wells. By remotely monitoring these parameters, system operating problems could be quickly identified and resolved. Also included in the system were three dosing pumps and a bromide solution tank for adding sodium bromide tracer to each of the three injection wells during tracer testing.

Once installed, the groundwater recirculation system was tested to insure proper operation of pumps and controls. Each of the three groundwater recirculation loops were operated at approximately 0.5 gpm during the testing. During this process, steps were taken to simulate various operating and alarm conditions and all equipment and sensors were checked for proper calibration. Equipment and sensors were monitored to insure all data was being communicated and logged accurately.



Figure 5.25. Photographs of the Conex Box and Groundwater Recirculation System

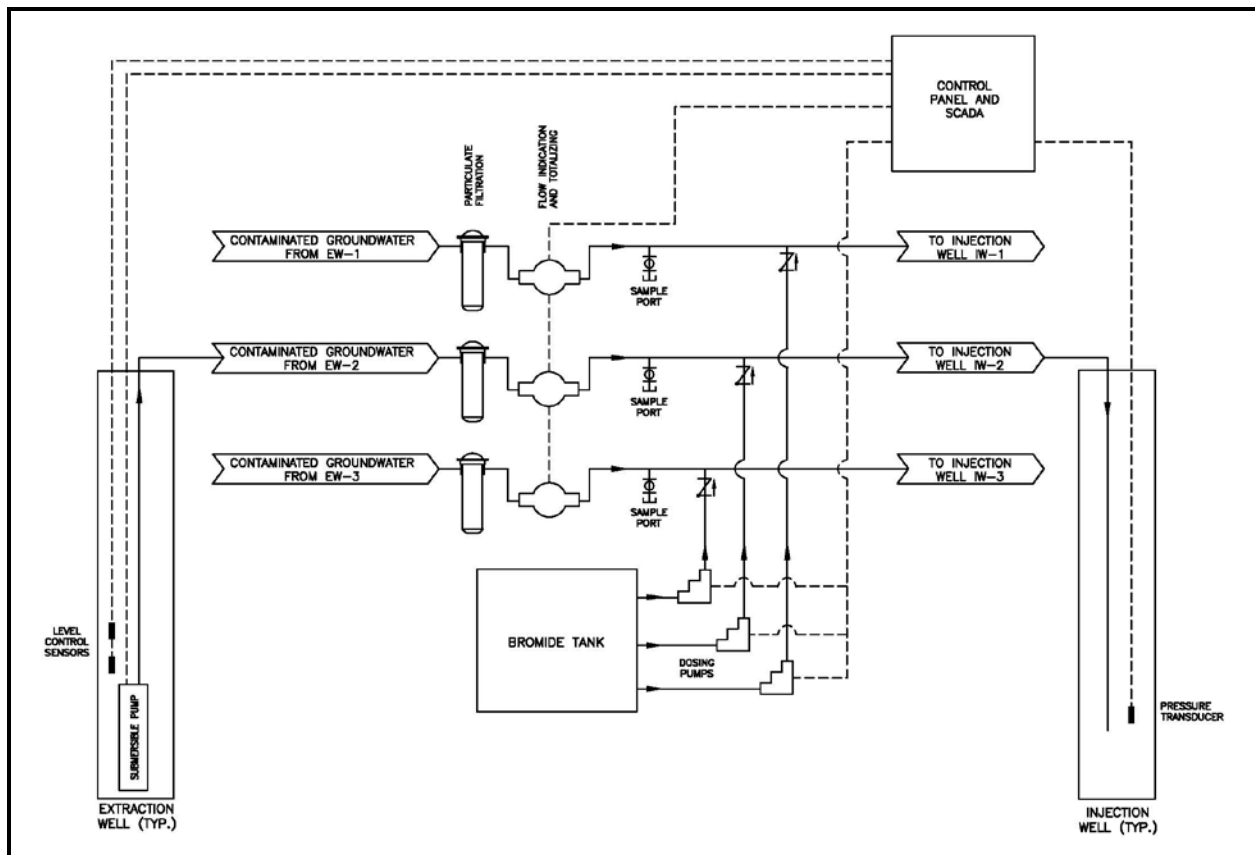


Figure 5.26. Process Flow Diagram of the Groundwater Recirculation System



Figure 5.27. Photograph of Extraction Well Vaults, Trenches and Conduits

5.4.9 Solar Power PRT System

The PRT system was completely powered via an off-the-grid solar power system. The system consisted of four 85 watt photovoltaic solar panels, and four deep discharge 80 amp hour 12V batteries. The batteries were connected in parallel, with two batteries in each series, providing a 24V DC power supply. A solar charge controller regulated the charging of the batteries when there was sufficient sunlight, and the system operated off of stored battery power when there was not sufficient sunlight to operate the system and/or charge the batteries. Wire leads (16 gauge wire) were run from the five electrodes and connected to a commercially-constructed control panel (**Figure 5.28**). The control panel was powered by the 24V DC power supply. Rheostats on the control panel were used to control voltage to each of the anodes. The maximum voltage at each anode was limited to 16 volts, and the voltage to each anode could be turned off independently of the other anodes. Voltage and current (in milliAmps) measured at the anodes were displayed on digital meters located on the front of the control panel (**Figure 5.28**). Polarity to the electrodes could be reversed via a selector switch on the control panel.



Figure 5.28. Photographs of the Front (left) and Inside (right) of the PRT Control Panel

5.5 FIELD TESTING

As summarized in **Table 5.14**, field testing activities included two baseline sampling events, tracer testing, four different phases of system operation with performance monitoring, and two bioaugmentation injection events. Each of these activities is discussed in detail in the following subsections.

5.5.1 Baseline Sampling

Prior to the startup of the PRT and groundwater recirculation systems, two baseline groundwater sampling events were performed. Baseline groundwater samples were collected from all 11 MLS performance monitoring wells (PMW-1 through PMW-11), and from MLS background monitoring well BMW-1 in October and November of 2011 (**Table 5.14**). Samples were collected from each of the 2-3 discrete sample intervals within these wells, for a total of 32 sample points. Samples were collected using peristaltic pumps, and dedicated Teflon tubing installed within the individual channels of the CMT MLS wells using low-flow sampling methods, as detailed in **Section 5.6.1**.

Samples from both events were analyzed for VOCs, reduced gases, anions, and dissolved H_2 (see **Sections 5.6.2** and **5.6.3**). Additionally, all samples from the second baseline event were analyzed for dissolved Fe and Mn. Baseline groundwater elevation data were also collected during these two events.

Table 5.14. Summary of Proton Reduction Demonstration Major Activities and Phases

Activity/Demonstration Phase	Start Date	Completion Date	Demonstration Timeline	Duration (Days)
Baseline Sampling Event #1	10/26/2011	10/27/2011	Days -47 and -46	2
Baseline Sampling Event #2	11/9/2011	11/10/2011	Days -33 and -32	2
Tracer Testing	11/14/2011	11/28/2011	Days -28 through -14	15
Phase 1-Proton Reduction Only (no groundwater recirculation)	12/12/2011	4/3/2012	Days 0 through 113	114
Phase 2-Proton Reduction & Groundwater Recirculation (extraction & injection wells)	4/4/2012	6/26/2012	Days 114 through 197	84
Phase 3-Proton Reduction & Groundwater Recirculation (extraction wells, re-injecting in cathode wells)	6/27/2012	7/31/2012	Days 198 through 232	35
Phase 4-Proton Reduction & Operation of Small Recirculation Loop (extracting from AW-2, injecting in CW-2)	8/1/2012	12/20/2013	Days 233 through 739	507

5.5.2 System Startup and Testing

Once the second round of baseline sampling was complete, the recirculation system was started and operated for two weeks prior to operation of the PRT system. Groundwater was pumped from each of the three extraction wells at a rate of 0.4 gpm, and re-injected into each corresponding injection well at the same rate. The system was operated continuously between November 14, 2011 and November 28, 2011 (**Table 5.14**).

During this two-week testing period, injection of the conservative tracer bromide (in the form of sodium bromide) was performed in the test plot to evaluate/verify local hydrogeologic characteristics, including hydraulic conductivity, heterogeneity, and vertical components of groundwater flow, and to determine the travel time between the injection and extraction wells. Tracer injection occurred continuously at the two Test plot injection wells (IW-1 and IW-2) for the entire two-week period. The tracer solution was prepared from sodium bromide and site groundwater water in a 30-gallon polyethylene tank. A final concentration of ~ 25.0 g/L as bromide was prepared in a tank, and then metered into the two injection wells at approximately 3 mL/min, thereby attaining a final bromide injection concentration of approximately 50 mg/L. Based on model simulations (**Figure 5.18**), this tracer delivery rate was expected to distribute bromide at concentrations >10 mg/L within the test plot monitoring wells and the two corresponding extraction wells (located 30 feet downgradient of the injection wells) within approximately 30-40 days. The tracer testing results, discussed in **Section 5.7.1**, showed groundwater velocities consistent with the groundwater model. A total of approximately 3.9 kg (8.6 lbs.) of sodium bromide was injected during this two week period.

Groundwater samples were collected for bromide analysis at five time points during the 2-week startup period using low flow sampling methods, as detailed in **Section 5.6.1**.

Samples were collected from all 11 MLS well monitoring wells (29 sample points) within the Test and Control plots, as well as the three extraction wells during each event to determine the vertical and horizontal distribution of the bromide tracer with time. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and bromide testing results are provided in **Section 5.7.1**.

Additionally, groundwater elevation data were collected within the demonstration monitoring well network during system startup and testing to monitor changes in groundwater elevations within the test plots, and in and around the extraction and injection wells during their operation.

5.5.3 System Operation

After system start-up and tracer testing, system operation during the demonstration was divided into the following four distinct stages (**Table 5.14**).

5.5.3.1 Phase 1 – Proton Reduction Only

Phase 1 began on December 12, 2011 (day zero), and involved operation of the PRT system for 114 days without the groundwater recirculation system operating. This initial operational phase was used to optimize operation of the PRT system, as well as to monitor geochemical changes within the electrode wells and nearby performance monitoring wells. This phase allowed for assessment of H₂ production and changes in groundwater pH within the cathode wells. It also allowed for evaluation of any potential generation of H₂ between cathodes and anodes, and transport of H₂ and/or downgradient changes of pH under natural groundwater gradients. At startup, the PRT system was operated at approximately 1 V, before being increased incrementally to 16 V on January 16, 2012 (day 35). Currents between approximately 250 mA and 300 mA were measured in the Test Plot while operating at 16 V.

Groundwater samples were collected for H₂ analysis and field parameters at eight time points during this 114-day period using low flow sampling methods, as detailed in **Section 5.6.1**. Samples were collected from each level of the MLS monitoring wells located closest to the electrode wells (PMW-4, 5, 7, 9, and 10) within the test and control plots, as well as the three cathode wells and two anode wells to evaluate hydrogen generation and distribution, and changes in groundwater geochemistry. Groundwater samples were also collected on day 105 for analysis of VOCs, reduced gases, anions, and dissolved hydrogen. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and results from Phase 1 testing are provided in **Section 5.7**. System operating parameters were monitored by field personnel approximately 1 to 2 times per week during Phase 1. These parameters included solar power system operational parameters and PRT system voltages and currents.

5.5.3.2 Phase 2 – Proton Reduction & Groundwater Recirculation Using Extraction and Injection Wells

Phase 2 of system operation began on April 4, 2012, and consisted of an 84-day period during which groundwater recirculation was performed using the three recirculation loops, and the PRT system was in continuous operation. Groundwater was recirculated at a rate of 0.25 gpm for 15 days, and at a rate of 0.4 gpm for the remaining 69 days at each of the three loops. The PRT system was operated between approximately 10 and 16 V, with currents between approximately 140 mA and 250 mA measured in the test plot. These were the approximate designed operational settings, and were intended to be the normal operating conditions for the remainder of the demonstration.

Although high pH groundwater (up to pH 11.5) and elevated H₂ concentrations were achieved in the cathode wells during Phases 1 and 2 of the demonstration, the impact of the treatment was not observed in any of the downgradient MLS monitoring wells, including PMW-4S/I/D located 2.5 feet down gradient of cathode CW-2. The lack of observed impact at this MLS monitoring well was thought to be possibly due to a lack of hydraulic connection between the cathode well and the monitoring well that prevented water from the cathode well from being transported to the monitoring well (e.g., no flow through the cathode well or no flow between cathode well and the monitoring well).

In order to determine if groundwater leaving cathode CW-2 was migrating downgradient to MLS monitoring well PMW-4S/I/D during active groundwater recirculation, a second tracer test was performed. This test involved injecting bromide tracer at the three cathode wells in small slugs over four consecutive days and monitoring distribution of the tracer. A one liter solution of distilled water containing 250 grams of sodium bromide was added to each of the three cathode wells each day from June 11, 2012 through June 14, 2012 (days 182 through 185). Groundwater samples were collected for bromide analysis and field geochemical parameters immediately prior to the first bromide addition (day 182), and at three time points during the 8-day test. Samples were collected from all 11 MLS well monitoring wells (29 sample points) within the test and control plots, as well as the three cathode wells and three extraction wells during each event to determine the vertical and horizontal distribution of the bromide tracer with time. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and bromide testing results are provided in **Section 5.7.1**.

Groundwater samples were also collected for dissolved H₂ analysis and field geochemical parameters at five time points during this phase of operation. These samples were collected at select wells, as summarized in **Sections 5.6.2** and **5.6.3**. System operating parameters were monitored by field personnel approximately one to two times per week during active recirculation. These parameters included injection/extraction well flow rates, solar power system operational parameters, and PRT system voltages and currents.

The objective of this phase of operation was to enhance groundwater transport in order to evaluate H₂ transport and increase groundwater pH downgradient of the cathodes. However, because of apparent groundwater flow paths, and the lack of dissolved H₂ distribution and pH increases observed at test plot wells during this 84-day period, the performance period of this operational phase was shortened and modifications were made as described in Phase 3 below.

5.5.3.3 Phase 3 – Proton Reduction & Groundwater Recirculation Using Extraction and Cathode Wells

Phase 3 of system operation began on June 27, 2012, and lasted 35 days. To better distribute the H₂ and OH⁻ being generated in the cathode wells, the groundwater recirculation system was reconfigured so that the extracted groundwater was re-injected directly into the three cathode wells, rather than the three injection wells. Groundwater recirculation rates were reduced to 0.1 gpm at each loop during this phase of the demonstration. This approach was performed specifically to ensure that water within the cathode well, which contained elevated H₂ concentration and high pH, was transported into the test plot. Dissolved H₂ and pH data collected during this phase of the demonstration indicated that groundwater being re-injected into the cathode wells was still not reaching nearby downgradient MLS monitoring wells. Thus, additional changes to the plot configuration were made as described in Phase 4 below.

5.5.3.4 Phase 4 – Proton Reduction & Operation of Small Recirculation Loop

Phase 4 of system operation began on August 1, 2012, and lasted 507 days. To adjust for the limitations observed during Phases 2 and 3, and to take advantage of the observed connection between cathode well CW-2 and MLS monitoring well PMW-7S/I/D, the groundwater recirculation system was modified to create a small recirculation loop (**Figure 5.29**) to move groundwater between AW-2 (which served as the extraction well) and CW-2 (which served as both a cathode and an injection well). The electrode in AW-2 was removed, and well CW-1 was converted into an anode for the remainder of the demonstration. A submersible air-driven bladder pump was installed in well CW-2, and a small air compressor and a solar-powered pump controller were installed to operate the bladder pump. MLS monitoring wells PMW-7S/I/D and PMW-8S/I/D served as performance monitoring wells during this final phase of the demonstration. This 507-day operation phase was where most of the useful project data were derived.

During Phase 4, groundwater was recirculated at a rate of approximately 80 mL/min for the first 61 days, and at a rate of approximately 400-500 mL/min for the remaining 446 days within the new groundwater recirculation loop. The PRT system was operated continuously at 16 V, with currents between approximately 350 mA and 450 mA measured in the new test plot area.

In order to determine connectivity of MLS monitoring wells PMW-7S/I/D and PMW-8S/I/D and groundwater travel times within the new groundwater recirculation loop, a third tracer test was performed. On October 1, 2012, when the recirculation rate was increased to 500 mL/min, a 2 liter solution containing 500 grams of sodium bromide was added to injection well CW-2. Groundwater samples were collected for bromide analysis and field geochemical parameters immediately prior to the bromide addition (day 294), and at three time points during the 8-day test. Samples were collected from MLS monitoring wells PMW-4S/I/D, PMW-7S/I/D, and PMW-8S/I/D, and wells CW-2 and AW-2 during each event to determine the vertical and horizontal distribution of the bromide tracer with time. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and bromide testing results are provided in **Section 5.7.1**.

A new round of baseline groundwater samples were collected at MLS monitoring wells PMW-4S/I/D, PMW-7S/I/D, and PMW-8S/I/D, and wells CW-2 and AW-2 two days prior to Phase 4 startup. Groundwater samples were collected for VOCs, reduced gases, anions, and dissolved H₂ analysis and field geochemical parameters during this event. An additional ten performance sampling events were performed during Phase 4 that included the PMW-7 and PMW-8 MLS monitoring well intervals, and at times MLS monitoring well PMW-4 and/or wells CW-2 and AW-2. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and results are provided in **Section 5.7**. System operating parameters were monitored by field personnel approximately one to two times per week during active re-circulation. These parameters included injection/extraction well flow rates, solar power system operational parameters, and PRT system voltages and currents.

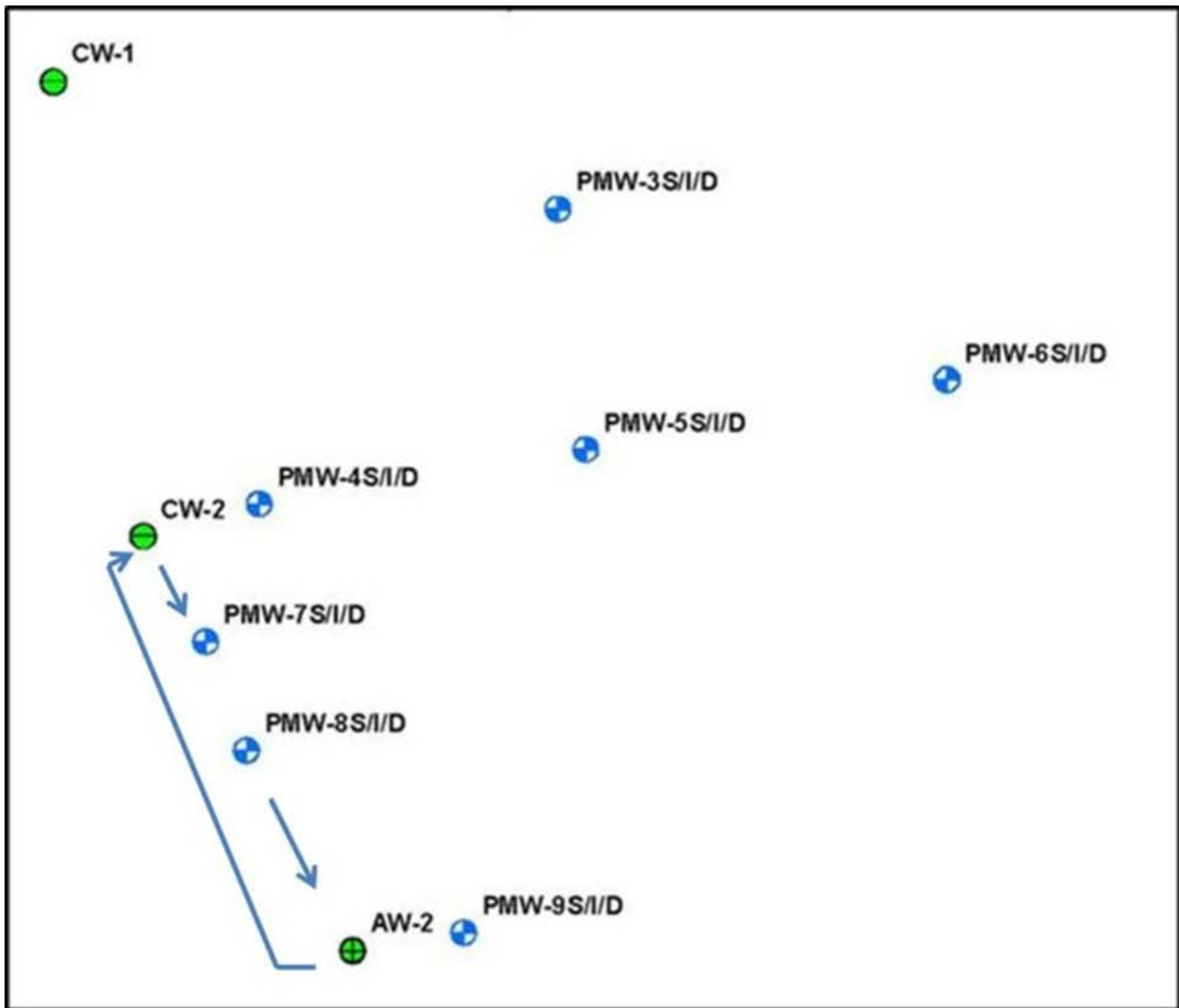


Figure 5.29. Plan View of the Proton Reduction Test Plot Used During Phase 4 of the Demonstration.

The blue arrows show the orientation of the recirculation loop constructed using AW-2 (extraction) and CW-2 (injection).

5.5.4 Bioaugmentation

Based on laboratory studies performed at the beginning of the project (**Section 5.3.2**), a microbial population capable of completely dechlorinating of TCE was not detected in site samples, presumably because of the low natural groundwater pH. Consequently, bioaugmentation injections with CB&I's SDC-9 dechlorination culture were performed at well CW-2 on January 17, 2013 and October 10, 2013 (days 402 and 668, respectively). The culture was grown in CB&I's fermentation facility in Lawrenceville, NJ, and transferred to a soda keg with a nitrogen headspace. The keg was placed in a cooler with ice packs, and driven directly to the site. Once the bioaugmentation culture was on site, groundwater was pumped from well CW-2 into 5-gallon buckets to be used as chase water. Tubing was lowered down to the bottom of well CW-2, and connected to the pressurized soda keg. A valve on the keg was opened, forcing the culture through the tubing and into the well. The tubing was raised and lowered across the well screen during the SDC-9 injection period, which lasted less than one minute. Following is a summary of bioaugmentation culture injection volumes and cell density, as well as chase water volumes:

- Bioaugmentation #1: 0.7 Liters of SDC-9 culture at a concentration of $10E^{11}$ cells/L, with 5 gallons of chase water.
- Bioaugmentation #2: 2.0 Liters of SDC-9 culture at a concentration of $10E^{11}$ cells/L, with 15 gallons of chase water.

Groundwater samples for DHC quantification (via qPCR) were collected during Phase 4 from MLS monitoring wells PMW-7S/I/D and PMW-8S/I/D within the small recirculation loop immediately prior to and approximately two months after the first bioaugmentation event. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and qPCR results are provided in **Section 5.7.7**.

Additionally, diammonium phosphate (nutrients) was added to well CW-2 on October 15, 2013, five days after the second bioaugmentation event. Groundwater was pumped from well CW-2 into 5-gallon buckets to be used as mix and chase water. A total of 1.8 kg (4 lbs.) of diammonium phosphate was mixed into 5 gallons of groundwater, and pumped into well CW-2 using a sump pump. An additional 7 gallons of chase water was pumped into the well to further distribute the nutrients within the aquifer.

5.5.5 Decommissioning

At the conclusion of the demonstration, the groundwater recirculation and PRT systems were disconnected and removed from the site with all associated surface materials. The groundwater recirculation system was shipped to Edwards Air Force Base, CA, to be used on ESTCP project ER-201210. The PRT system was modified, and shipped to Marine Corps Base Quantico, Quantico, VA, to be used on AFCEC project Number 501. With the exception of site characterization wells DMW-1S and DMW-1D, all of the wells installed the demonstration were abandoned in accordance with relevant state regulations. The MLS monitoring wells were overdrilled, pulled, and the borehole sealed with cement-bentonite grout. The extraction, injection, and electrode wells were sealed with cement-bentonite grout, and the casing cut approximately 1-foot below grade. All surface completions were removed, and the well locations were re-graded and seeded as necessary. System decommissioning activities were performed in April, 2014, and well decommissioning was completed in October 2014.

5.6 SAMPLING METHODS

5.6.1 Groundwater Sampling

Groundwater samples were collected by CB&I personnel utilizing low-flow purging in general accordance with NJDEP Low Flow Purging and Sampling Guidance (NJDEP, 2003). Prior to each sampling event, the well ID and sample interval were checked and recorded on a field sheet. Groundwater elevation measurements were then collected using an electronic water level probe (Solinst 101 water level meter, or equivalent) prior to purging and collecting groundwater samples. Measurements were obtained from the top-of-casing and recorded to the nearest 0.01-ft, and were recorded on field sampling sheets. Groundwater elevation data were used to determine water table elevations and hydraulic gradient within the demonstration area.

Dedicated Teflon tubing was used to sample each of the wells/intervals, and therefore did not require decontamination. A peristaltic pump with dedicated tubing was used to withdraw water from the MLS well intervals at a typical flow rate between 0.1 to 0.25 L/min. Water level in the well was monitored and recorded during purging. It was desirable, although not always achievable, that <0.3 ft of drawdown occur in the well during purging. Pumping rates were adjusted accordingly if drawdown was observed to be too great. For some of the demonstration wells, drawdown was greater than 0.3 feet even at 0.1 L/min due to low groundwater yield. The extent of drawdown in each well was recorded during stabilization.

Purged water was pumped through a flow cell connected to an in-line multi-parameter groundwater meter (YSI 6820 or equivalent). Parameters, including temperature, conductivity, dissolved oxygen, oxidation-reduction potential (ORP), turbidity, and pH were measured as a function of pumping time, and the values recorded on a field sheet approximately every 5 minutes. An example field sheet is provided in **Figure 5.30**. Water was purged from the well until all parameters were stable for three consecutive readings, or for a maximum of 30 minutes (to minimize the volume of groundwater removed from the formation in the closely-spaced MLS well intervals). Stability was defined as variation of <1% for pH, <3% for temperature and specific conductivity, and <10% for dissolved oxygen, ORP, and turbidity. When parameters were stable according to the above guidelines, sampling time was recorded and all samples were collected. The final data collected on each field sheet was recorded in the project database as the measured readings in each well.

The procedures used in collecting groundwater samples during the demonstration are described below. After well parameters were stabilized during low flow sampling, or the well had been purged for 30 minutes (whichever came first), samples were collected in the following order (as applicable), using the following procedures:

- Dissolved H₂: One (1) 160-mL glass serum bottle preserved in the field with HCl (pH <2) preservative and crimp-sealed with a Teflon-lined septum and aluminum crimp cap was filled directly from the groundwater purge stream. The bottles were completely filled, with zero headspace (the bottle was filled to the top resulting in a convex meniscus). The vial was then crimp-sealed and placed on adequate ice for shipment.

MONITORING WELL ID: CW-2

Well Depth (ft-bloc):

Depth to Water Prior to Purging (ft-bloc): 7.47' TOC

Well Casing Diameter (in): 2"

Start Time (purgin): 0904

Sampling Date: 8-30-12

Sampler(s): P. Halman

Sampling Device: Peristaltic Pump

Weather Conditions: Sunny, 75°

[illegible]

Sample Time: 0919

Analytes Sampled: H₂, Anions

Volume Purged through qPCR filter (ml): _____

Comments:

- VOCs: Three (3) 40 mL glass VOA vials with HCl (pH <2) preservative and with Teflon-lined caps were filled directly from the groundwater purge stream. The bottles were completely filled, with zero head-space (the bottles were filled to the top resulting in a convex meniscus). The vials were then capped and placed on adequate ice for shipment.
- Reduced gases: Two (2) 40 mL glass VOA vials with HCl (pH <2) preservative and with Teflon-lined caps were filled directly from the groundwater purge stream. The bottles were completely filled, with zero head-space (the bottles were filled to the top resulting in a convex meniscus). The vials were then capped and placed on adequate ice for shipment.

- Anions and VFAs: One (1) 100 mL sample jar (plastic, no chemical preservatives) was filled to the top with water. The jar was then capped and placed on adequate ice for shipment. This sample was used for analysis of anions (nitrate, nitrite, sulfate, chloride, bromide) and VFAs (lactic acid, acetic acid, propionic acid, formic acid, butyric acid, pyruvic acid, and valeric acid).
- DHC: One (1) 1 Liter sample jar (glass, no chemical preservatives) was filled to the top with water. The jar was then capped and placed on adequate ice for shipment.
- Dissolved metals: One (1) 500 mL amber glass jar preserved with nitric acid was filled with water that was filtered in the field using a 0.45 micron in-line filter. The jar was then capped and placed on adequate ice for shipment. The samples were used for analysis of dissolved iron and manganese.

5.6.2 Groundwater Analysis

Groundwater samples were submitted to CB&I's Analytical and Testing Laboratory in Lawrenceville, NJ for analysis of VOCs, reduced gases, anions, dissolved hydrogen, VFAs, and for quantification of DHC via qPCR. Dissolved Fe and Mn analyses were performed by Chemtech, located in Mountainside, NJ. The analytical methods for groundwater samples collected during the field demonstration are summarized in **Table 5.15**. Field geochemical parameters, including pH, DO, specific conductivity, ORP and turbidity were measured at the site during well purging using a field meter, as described in **Section 5.6.1**.

5.6.3 Numbers and Types of Samples Collected

The numbers and types of groundwater samples collected during the demonstration are provided in **Table 5.16**. Just prior to the start of field testing, 5 bromide sampling events were performed at 32 wells as part of a bromide tracer test that occurred over 13 days (See **Section 5.5.2**). Two rounds of baseline groundwater sampling were conducted from the 12 MLS monitoring wells on Days -46 and -43 before system start-up (Day 0) (See **Section 5.5.1**). Performance samples were collected during four separate phases of system operations that lasted 507 days, as summarized in **Table 5.14** (See **Section 5.5.1**).

Table 5.15. Analytical Methods for Groundwater Samples Collected During the Field Demonstration.

Analyte ¹	Method/ Laboratory	Preservative	Bottle	Hold time
VOCs	EPA 8260 CB&I	4°C with HCl	40 mL VOA vial x 2, no headspace	14 days
Anions	EPA 300.0 CB&I	4°C	100 mL polyethylene screw-cap	2 days (NO ₃ , PO ₄); 28 days all others
Volatile Fatty Acids (VFAs)	EPA 300.0m CB&I	4°C	100 mL polyethylene screw-cap	14 days
<i>Dehalococcoides</i> (DHC)	qPCR CB&I ²	4°C	950 mL sterile screw-cap	NA ³
Reduced Gases	EPA 3810, RSK175 CB&I ²	4°C with HCl	40 mL VOA vial x 2 No headspace	14 days
Dissolved Hydrogen	EPA 3810, RSK175 CB&I ²	4°C with HCl	125 mL serum bottle, Teflon- lined butyl rubber septa and crimp seal, No headspace	7 days
Metals	EPA 200.7 Chemtech	4°C with HNO ₃	250 mL polyethylene screw-cap	6 months
Redox Potential	Field Meter	--	--	NA
Dissolved Oxygen	Field Meter	--	--	NA
pH	Field Meter	--	--	NA
Conductivity	Field Meter	--	--	NA

¹ All analyses are in groundwater

² Not a standard EPA Method.

³ NA, Not applicable

Table 5.16. Total Number and Types of Samples Collected During the Demonstration

Phase	Event	Occurrence	Number of Samples	Analyte	Location
Baseline Sampling	Baseline Sampling #1	Day -46	32	VOCs, reduced gases, dissolved hydrogen, anions	Every interval at all 11 PMWs and BMW-1
	Baseline Sampling #2	Day -33	32	VOCs, reduced gases, dissolved hydrogen, anions, dissolved Fe and Mn	Every interval at all 11 PMWs and BMW-1
Recirculation System Startup and Testing	Bromide Tracer Testing #1	5 Events (Days -26, -24, -21, 19, and -14)	32 sample points; 160 total samples	Anions (bromide)	Every interval at all 11 PMWs, all 3 EWs
Phase 1	Dissolved Hydrogen Sampling	8 Events (Days 0, 16, 24, 28, 31, 35, 57, and 113)	19 sample points; 152 total samples	Dissolved hydrogen	PMW -4, 5, 7, 9, 10 (all depths), all 3 CWs, both AWs
	Performance Sampling	Day 105	32	VOCs, reduced gases, dissolved hydrogen, anions	All 11 PMWs, all 3 BMWs
Phase 2	Dissolved Hydrogen Sampling	Day 128	25	Dissolved hydrogen	PMWs 4, 5, 6, 7, 10, 11 (all depths), All 3 BMWs, All 3 CWs, All 3 EWs
		Day 135	3		PMW 4 (all depths).
		Day 142	9		PMWs 4S, 4I, 4D, 5S, 5I, All 3 BMWs, CW-2
		Day 170	21		PMWs 4, 5, 7, 8, 10 (all depths), All 3 EWs, All 3 CWs, AW-2
		Day 178	19		PMWs 4S, 4I, 4D, 5S, 5D, 7S, 7I, 7D, 8S, 8I, 8D, 10S, 10I, All 3 EWs, All 3 CWs
	Bromide Tracer Testing #2	4 Events (Days 182, 184, 186, and 190)	33 sample points; 132 total samples	Anions (bromide)	PMWs 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 (all depths), All 3 EWs, All 3 CWs
Phase 3	Performance Sampling Event	Day 231	9	VOCs, reduced gases, dissolved hydrogen, anions	PMWs 4, 7, and 8 (all depths)
Phase 4	Bromide Tracer Testing #3	4 Events (Days 294, 295, 296, and 298)	11 sample points; 44 total samples	Dissolved hydrogen, anions	PMWs 4, 7, and 8 (all depths), CW-2, AW-2
	Performance Sampling Event #1	Day 316	12	VOCs, reduced gases, dissolved hydrogen, anions, dissolved metals, alkalinity	PMWs 4, 7, and 8 (all depths), BMW-1S, CW-2, AW-2
	Dissolved Hydrogen Sampling	Day 339	11	Dissolved hydrogen	PMWs 4, 7, and 8 (all depths), CW-2, AW-2
		Day 547	10		PMWs 4, 7, and 8 (all depths), CW-2
	Dissolved Hydrogen & Anion Sampling	Day 358	11	Dissolved hydrogen, anions	PMWs 4, 7, and 8 (all depths), CW-2, AW-2
	Performance Sampling Event #2	Day 372	7	VOCs, reduced gases, dissolved hydrogen, anions, dissolved and total metals	PMWs 7 and 8 (all depths), CW-2
	Performance Sampling Events #3 (pre-bioaugmentation), 4, 5, and 6	2 Events (Days 402 and 423)	7	VOCs, reduced gases, dissolved hydrogen, anions, TOC	PMWs 7 and 8 (all depths), BMW-1S.
		2 Events (Days 458 and 499)	8		PMWs 7 and 8 (all depths), BMW-1S, CW-2
	Performance Sampling Event #7	Day 568	6	VOCs, reduced gases, dissolved hydrogen, anions, dissolved metals	PMWs 7 and 8 (all depths)
	Performance Sampling Events #8, 9, and 10	Day 645	6	VOCs, reduced gases, dissolved hydrogen, anions	PMWs 7 and 8 (all depths).
		2 Events (Days 701, and 737)	7 sampling points; 14 total samples		PMWs 7 and 8 (all depths), BMW-1S

PMW – Multi-level Performance Monitoring Well
BMW – Multi-level Background Monitoring Well
EW – Extraction Well
CW – Cathode Well
AW – Anode Well

5.6.4 Quality Assurance for Groundwater Sampling and Analysis

Calibration Procedures and Frequency. Calibration refers to the checking of physical measurements of both field and laboratory instruments against accepted standards. It also refers to determining the response function for an analytical instrument, which is the measured net signal as a function of the given analyte concentration. These determinations have a significant impact on data quality and are performed regularly. In addition, preventative maintenance is important to the efficient collection of data. For preventative maintenance purposes, critical spare parts were obtained from the instrument manufacturer.

All field and laboratory instruments were calibrated according to manufacturers' specifications. All CB&I laboratory instruments were calibrated in accordance with established Standard Operating Procedures. Calibration was performed prior to initial use, during periods of extended use, and after periods of non-use. Certified standards were used for all calibrations and calibration check measurements. A calibration logbook was maintained by CB&I field and laboratory QA personnel.

Quality Control Samples. Internal QC data provides information for identifying and defining qualitative and quantitative limitations associated with measurement data. Analysis of the following types of QC samples provided the primary basis for quantitative evaluation of field data quality:

Field QC Samples:

- Trip blanks to evaluate the presence of contamination from handling errors or cross-contamination during transport;
- Field duplicates to assess the homogeneity of samples received by the laboratory as well as the homogeneity of contaminants in the matrix.

Trip Blanks. Trip blanks were prepared by the analytical laboratory with purified water for groundwater samples. The water was sent to the site in the same containers to be used for collection of the samples. Trip blanks were submitted at a frequency of one trip blank per shipment of samples for VOC analysis. For non-VOC analyses, no trip blanks were deemed necessary and none were submitted.

Field Duplicate Samples. Field duplicate samples were analyzed for all parameters to evaluate the accuracy of the analytical process. Each duplicate was run at a frequency of at least 5 percent of the total number of environmental samples. A comparison of the detected concentrations in the duplicate samples was performed to evaluate precision.

Sample Documentation. CB&I Lawrenceville, NJ project staff coordinated shipment and receipt of sample bottles, coolers, ice packs, chain of custody (COC) forms, and custody seals. Upon completion of sampling, the COC was filled out and returned with the samples to the CB&I and Chemtech laboratories. An electronic copy of each COC form was placed in the project database. An important consideration for the collection of environmental data is the ability to demonstrate that the analytical samples have been obtained from predetermined locations and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented to accomplish this. Documentation was accomplished through a COC Record that recorded each sample and the names of the individuals responsible for sample collection, transport, and receipt. A sample is considered in custody if it is:

- in a person's actual possession;
- in view after being in physical possession;
- sealed so that no one can tamper with it after having been in physical custody; or
- in a secured area, restricted to authorized personnel.

Sample custody was initiated by field personnel upon collection of samples. Samples were packaged appropriately to prevent breakage or leakage during transport, and shipped to the laboratory via either hand delivery or commercial carrier.

Sample Identification. A discrete well number was assigned to each sample. This discrete identifier was placed on each bottle and was recorded, along with other pertinent data in a field notebook dedicated to the project. The sample identification number designated the sample location (e.g., "PMW-2S" for this specific monitoring well). The bottle label also contained the site name, the sampling date and time, any preservatives added to the bottle, and the initials of the sampler.

Chain-of Custody Forms. The COC Record used by CB&I's laboratory is shown in **Figure 5.31**. All samples collected for off-site analysis were physically inspected by the Field Engineer prior to shipment.

Each individual who had sample in their possession signed the COC Record. Preparation of the COC Record was as follows:

- The COC Record was initiated in the field by the person collecting the sample, for every sample. Every sample was assigned a unique identification number entered on the COC Record.
- The record was completed in the field to indicate project, sampling person, etc.
- If the person collecting the samples did transport the samples to the laboratory or ship the samples directly, the first block for "Relinquished By _____, Received By _____" was completed in the field.
- The person transporting the samples to the laboratory or delivering them for shipment signed the record for as "Relinquished By _____".
- The original COC Record was sealed in a watertight container, taped to the top (inside) of the shipping container, and the shipping container sealed prior to being given to the commercial carrier.

The commercial waybill served as an extension of the COC Record between the final field custodian and receipt by the off-site laboratory.

- Upon receipt by the off-site laboratory, the laboratory QC Coordinator, or designated representative, opened the shipping container(s), compared the contents with the COC Record, and signed and dated the record. Any discrepancies were noted on the COC Record.
- COC Records were maintained with the records for the project, and became part of the data package.

- Sample numbers
- Type of samples
- Date and time received.

The COC Record was placed in the project file.

Other Documentation. Following sample receipt at the laboratory, the Laboratory Manager or sample custodian clearly documented the processing steps applied to the sample. The analytical data from laboratory QC samples were identified with each batch of related samples. The laboratory log book includes the time, date, and name of the person who logged each sample into the laboratory system. This documentation is thorough enough to allow tracking of the sample analytical history without aid from the analyst. At a minimum, laboratory documentation procedures provide the following:

- Recording in a clear, comprehensive manner using indelible ink.
- Corrections to data and logbooks made by drawing a single line through the error and initialing and dating the correction.
- Consistency before release of analytical results by assembling and cross-checking the information on the sample tags, custody records, bench sheets, personal and instrument logs, and other relevant data to verify that data pertaining to each sample are consistent throughout the record.
- Observations and results identified with the project number, date, and analyst and reviewer signatures on each line, page, or book as appropriate.
- Data recorded in bound books or sheaf of numbered pages, instrument tracings or hard copy, or computer hard copy.
- Data tracking through document consolidation and project inventory of accountable documents: sample logbook, analysis data book, daily journal, instrument logbook, narrative and numerical final reports, etc.

5.7 SAMPLING RESULTS

The results from tracer testing and performance monitoring performed during the four operations phases are summarized in the following subsections. As discussed in **Section 5.5.3**, and as summarized in **Table 5.16**, the majority of the performance sampling was performed during Phase 4 of the demonstration. The results for the each well for each parameter are provided in **Appendix D** on a well-by-well basis.

5.7.1 Tracer Testing

As detailed in **Section 5.5**, a total of three bromide tracer tests were performed during the field demonstration. The first test was performed during groundwater recirculation system start up and testing, prior to startup of the PRT system (**Tables 5.14** and **5.16**). Tracer testing was also performed during each of the operational phases that involved groundwater recirculation (Phases 2 through 4, respectively). Procedures and sampling schedules for each of the tracer tests are detailed in **Section 5.5**. The following summarizes the results from each test.

5.7.1.1 Tracer Test #1

Tracer test #1 was performed during the 2-week groundwater recirculation system startup and testing period. During tracer testing, groundwater was pumped from each of the three extraction wells at a constant rate of 0.4 gpm, and re-injected into each corresponding injection well at the same rate. Bromide was being introduced to the injection stream at a concentration of approximately 50 mg/L, and groundwater samples were collected for bromide analysis at 5 time points during the 14-day test. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and analytical data are presented in **Appendix D**.

Based on groundwater modeling simulations (**Section 5.4.3**), the peak concentrations of the bromide tracer was expected to reach the two corresponding extraction wells (located 30 feet downgradient of the injection wells) within approximately 30-40 days (0.75 to 1.0 ft/day). As shown on **Figure 5.32**, bromide at concentrations >1 mg/L were observed in all three monitoring intervals throughout most of the test plot within 14 days. The bulk of the bromide tracer concentration front (>10 mg/L) lagged behind the more dilute concentrations observed throughout the test plot. As expected, bromide was transported the fastest within the shallow zone (Layer 2, as shown in **Figures 4.3** and **5.20**), which consists of medium to coarse sand. Based on the distribution of the bromide, it is estimated that the bulk of the tracer was traveling through Layer 2 at a linear velocity of approximately 1.6 ft/day during active groundwater recirculation. The bromide tracer was traveling at a slower velocity of approximately 0.4 to 0.8 ft/day within the intermediate and shallow zones (Layers 3 and 4), which consist of lower permeability material (fine sand to sandy clay). These values are consistent with the groundwater velocities observed in the groundwater modeling simulations.

The sampling data showed fairly good distribution of the tracer in all three zones, with some exceptions. Unfortunately, one of our key MLS monitoring wells (PMW-4S/I/D) located 2.5 ft downgradient of cathode well CW-2, exhibited low tracer concentrations (<5 mg/L) in both the shallow and intermediate zones. These data suggested that these intervals were not well connected to the flow field within the test plot.

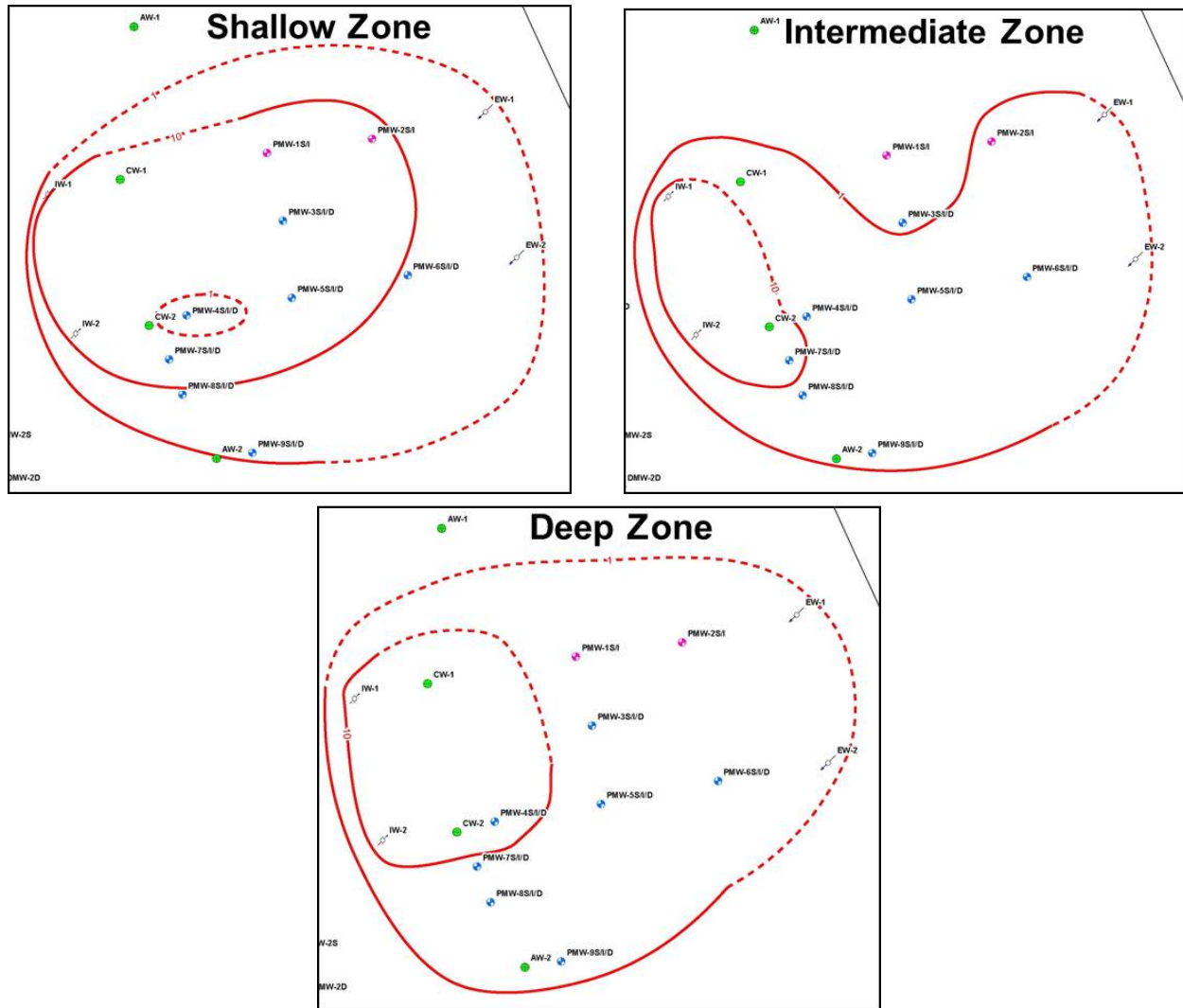


Figure 5.32. Day 14 Bromide Distribution in the Shallow, Intermediate and Deep Zones during the First Tracer Test

5.7.1.2 Tracer Test #2

Tracer test #2 was performed during Phase 2 of the demonstration to determine if groundwater leaving cathode CW-2 was migrating downgradient to MLS monitoring well PMW-4S/I/D during active groundwater recirculation. During tracer testing, groundwater was recirculated at a rate of 0.25 gpm at each of the three recirculation loops. As detailed in **Section 5.5.3**, this test involved injecting bromide tracer at the three cathode wells (located downgradient of the injection wells) in small slugs over four consecutive days and monitoring distribution of the tracer at the MLS wells. Groundwater samples were collected for bromide analysis at three time points during the 8-day test. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and analytical data are presented in **Appendix D**.

As shown on **Figure 5.33**, the bromide tracer was observed in more narrow plumes than during the first tracer test, because the tracer was added within the flow field, and not to the injection stream. This tracer test was designed to more accurately simulate the path that H_2 and OH^- being generated within the cathode wells would take. The sampling data showed that tracer flowing out of cathode well CW-2 was not reaching any of the three PMW-4 monitoring zones at relevant concentrations. However, tracer was detected in the deep zone of MLS well PMW-7 (which is located nearly perpendicular to the measured groundwater gradient) at concentrations >400 mg/L during the test. Overall, these tracer testing results showed unexpected flow paths and distribution of the bromide, and forced us to re-evaluate the operating conditions of the demonstration, as well as the sampling and monitoring program. These results, along with the lack of pH increases and dissolved H_2 distribution observed at test plot MLS wells during phase 2 (**Sections 5.7.2** and **5.7.3**, respectively), lead us to shorten this operational phase. As detailed in **Section 5.5.3**, modifications were made to the groundwater recirculation for Phase 3 of the demonstration to try to improve distribution of H_2 and OH^- being generated at the cathode wells.

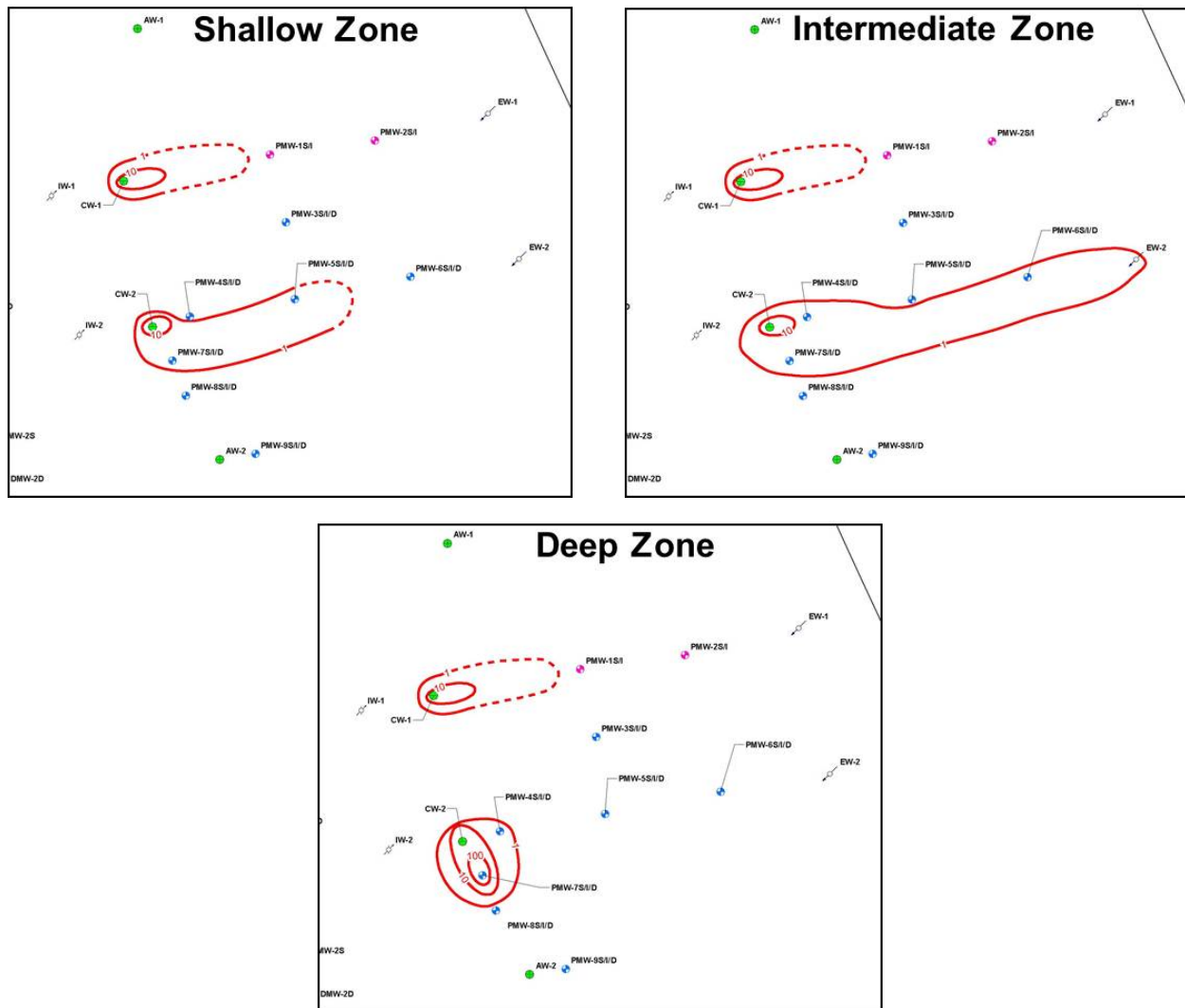


Figure 5.33. Day 8 Bromide Distribution in the Shallow, Intermediate and Deep Zones during the Second Tracer Test

5.7.1.3 Tracer Test #3

The third and final tracer test was performed at the beginning of Phase 4 of the demonstration, after modifications were made to the groundwater recirculation and PRT systems. As detailed in **Section 5.5.3**, the groundwater recirculation system was modified to create a small recirculation loop (**Figure 5.29**) to move groundwater between well AW-2 (which served as the extraction well) and CW-2 (which served as both a cathode and an injection well). The electrode in AW-2 was removed, and well CW-1 was converted into an anode for the remainder of the demonstration. A submersible air-driven bladder pump was installed in well CW-2, and groundwater was recirculated at a rate of approximately 400-500 mL/min for most of Phase 4.

Tracer Test #3 was conducted in order to determine connectivity of MLS monitoring wells PMW-7S/I/D and PMW-8S/I/D and groundwater travel times within the new groundwater recirculation loop. A 2 liter solution containing 500 grams of sodium bromide was added to injection well CW-2, and groundwater samples were collected for bromide analysis at three time points during the 8-day test (**Section 5.5.3**). Samples were collected from MLS monitoring wells PMW-4S/I/D, PMW-7S/I/D, and PMW-8S/I/D, and wells CW-2 and AW-2 during each event to determine the vertical and horizontal distribution of the bromide tracer with time. Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and analytical data are presented in **Appendix D**.

As shown on **Figure 5.34**, the bromide tracer was well distributed throughout all three layers of the revised treatment zone. Bromide concentrations >10 mg/L were observed in all three intervals of MLS wells PMW 7 and PMW-8 during the test. Groundwater velocities were estimated between approximately 0.3 and 0.6 ft/day. These results indicated that H₂ and OH⁻ generated at well CW-2 had the potential to be well distributed within the treatment zone.

5.7.2 pH Adjustment

One of the primary goals of this demonstration was to use PRT to increase aquifer pH via electrolysis and proton reduction. **Figure 5.35** shows groundwater pH measured in the three cathode wells. During Phase 1 of the demonstration, when only the PRT system was operating (no groundwater recirculation), the pH in the cathode wells increased to >10. During Phase 2 of the demonstration, the PRT system was operated at varying voltages/currents. As shown on **Figure 5.35**, even with active groundwater recirculation, pH in the cathode wells could be maintained at >10 when system voltage was ~16V and the measured current was >250 mA. However, during Phases 3 and 4, when groundwater was recirculated directly into the cathode wells, pH measured in the wells was only slightly higher than the pH of the recirculated groundwater.

Although high pH (to pH 11.5) was achieved in the cathode well groundwater (**Figure 5.17**) during Phases 1 and 2 of the demonstration, the impact of the treatment was not observed in any of the downgradient MLS monitoring wells, including PMW-4S/I/D located 2.5 feet down gradient of cathode CW-2. The lack of observed impact at this MLS monitoring well was possibly due to a lack of hydraulic connection between the cathode well and the monitoring well (as confirmed during tracer testing) that prevented water from the cathode well from being transported to this monitoring well.

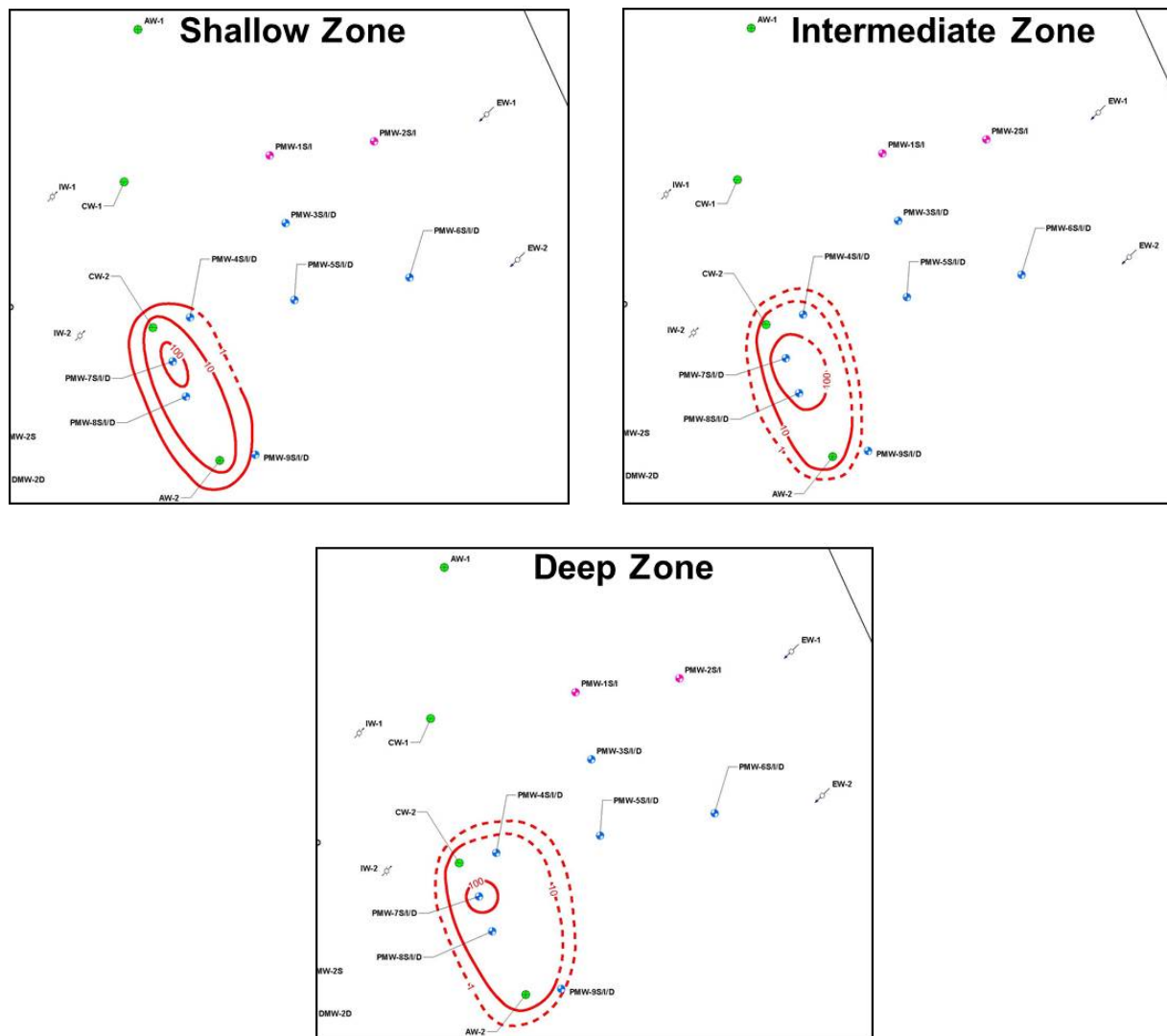


Figure 5.34. Day 4 Bromide Distribution in the Shallow, Intermediate and Deep Zones during the Third Tracer Test

Figures 5.36 and 5.37 show pH changes within the small Phase 4 recirculation loop at MLS monitoring wells PMW-7 and PMW-8, respectively. No significant increases in aquifer pH were observed at the PMW-7 and PMW-8 intervals during Phase 1 through Phase 3 of the demonstration. Upon initiating operation of the small recirculation system on day 233 (Phase 4), groundwater pH at some of the PMW-7 and PMW-8 intervals (especially in the PMW-7S) began to increase, and pH values near pH 6 were achieved. Because pH is a log scale, the increase in pH at some of these sample intervals indicated an approximately 10-fold reduction in acidity at this location. However, we were unable to consistently maintain pH > 6 throughout much of the treatment zone, which likely would have improved biological degradation of TCE. pH measurement locations and quantities are summarized in **Section 5.6.3**, and field measurement data are presented in **Appendix D**.

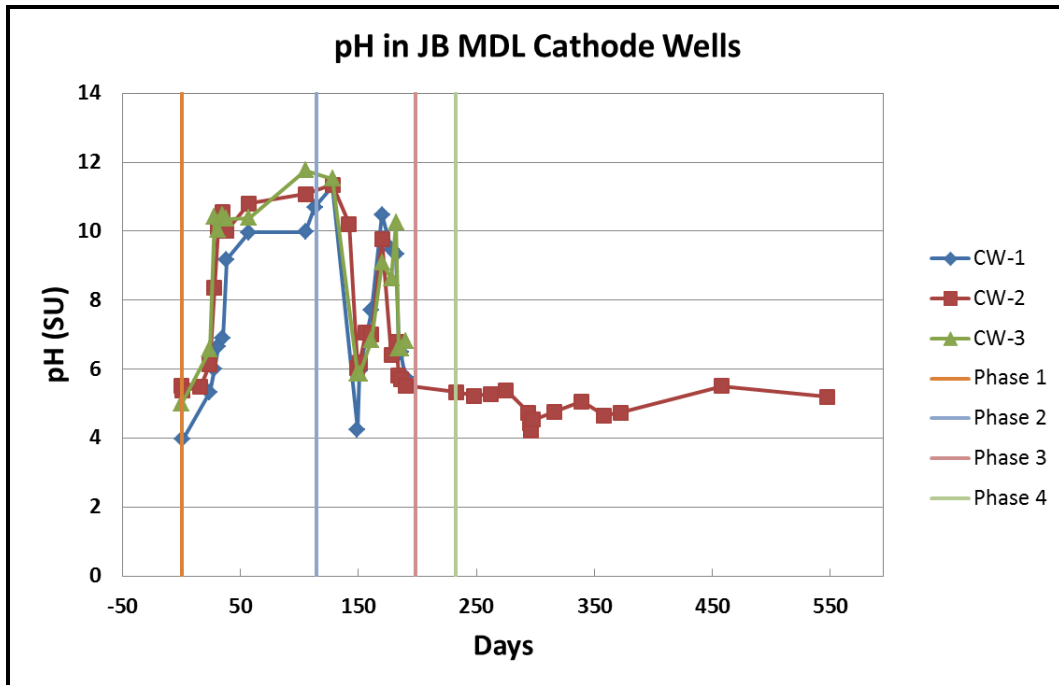


Figure 5.35. Groundwater pH Measured in Cathode Wells

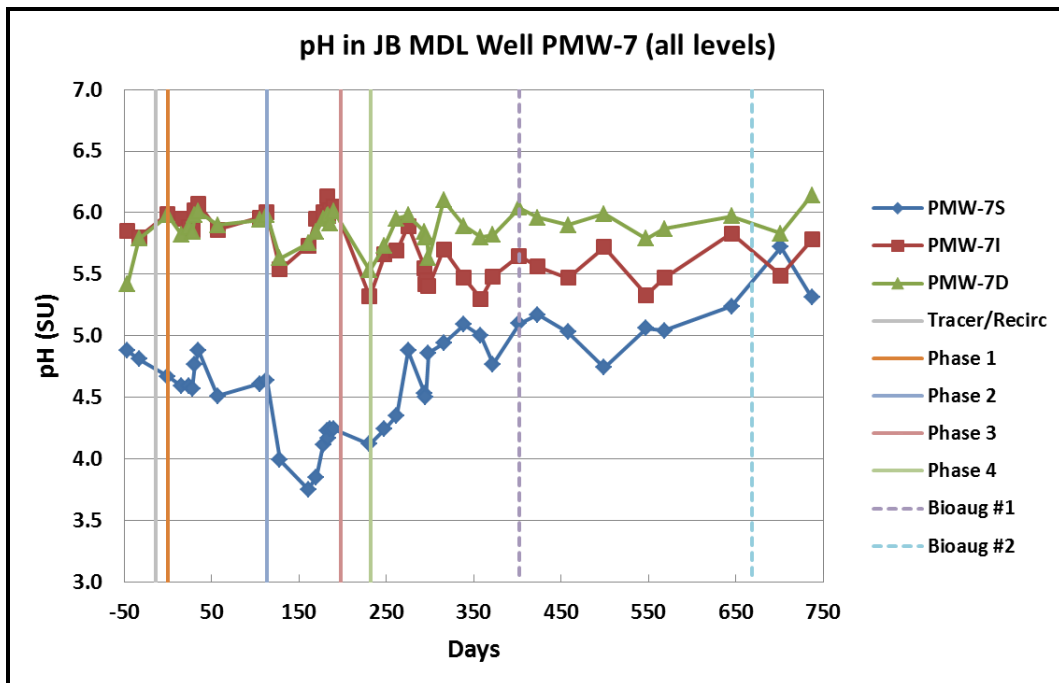


Figure 5.36. Groundwater pH Measured in MLS Monitoring Well PMW-7

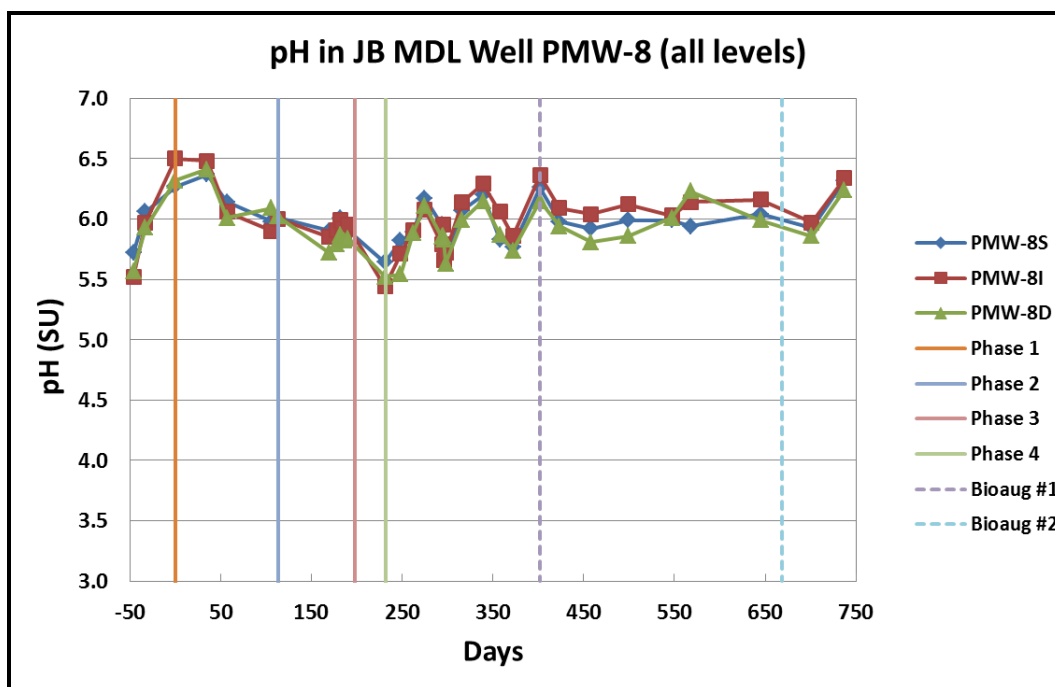


Figure 5.37. Groundwater pH Measured in MLS Monitoring Well PMW-8

5.7.3 Hydrogen Production and Distribution

H₂ concentrations in the demonstration plot cathode wells reached concentrations up to approximately 1,200 µg/L (**Figure 5.38**). H₂ concentrations in the cathode well groundwater remained saturated during Phase 1 and Phase 2 of the demonstration. During Phase 3 and Phase 4 of the demonstration, H₂ concentrations in the cathode well(s) decreased because the addition of extracted water to the cathode well (i.e., injection well) continually diluted H₂ concentrations and forced the H₂-containing groundwater into the aquifer.

Hydrogen concentrations measured at MLS monitoring wells PMW-7 and PMW-8 during the demonstration are shown in **Figures 5.39 and 5.40**, respectively. During the demonstration, H₂ concentrations occasionally exceeded the target concentration of 0.010 µg/L at the MLS wells closest to the cathode wells. However, H₂ concentrations were more typically below the detection level (<0.008 µg/L) at these wells. Furthermore, dissolved H₂ concentrations at the MLS wells PMW-7 and PMW-8 monitored during Phase 4 of the demonstration were typically below 0.010 µg/L. Considering H₂ concentrations at well CW-2 (cathode/injection well) were often >50 µg/L during this Phase, this suggests that there was a substantial sink for hydrogen between CW-2 (cathode/injection well) and the MLS wells (located 2.5 ft and 5.0 ft away, and within the recirculation loop). Possible sinks for hydrogen include iron and manganese reduction, sulfate reduction, acetogenesis, and methanogenesis, as well as dechlorination of TCE.

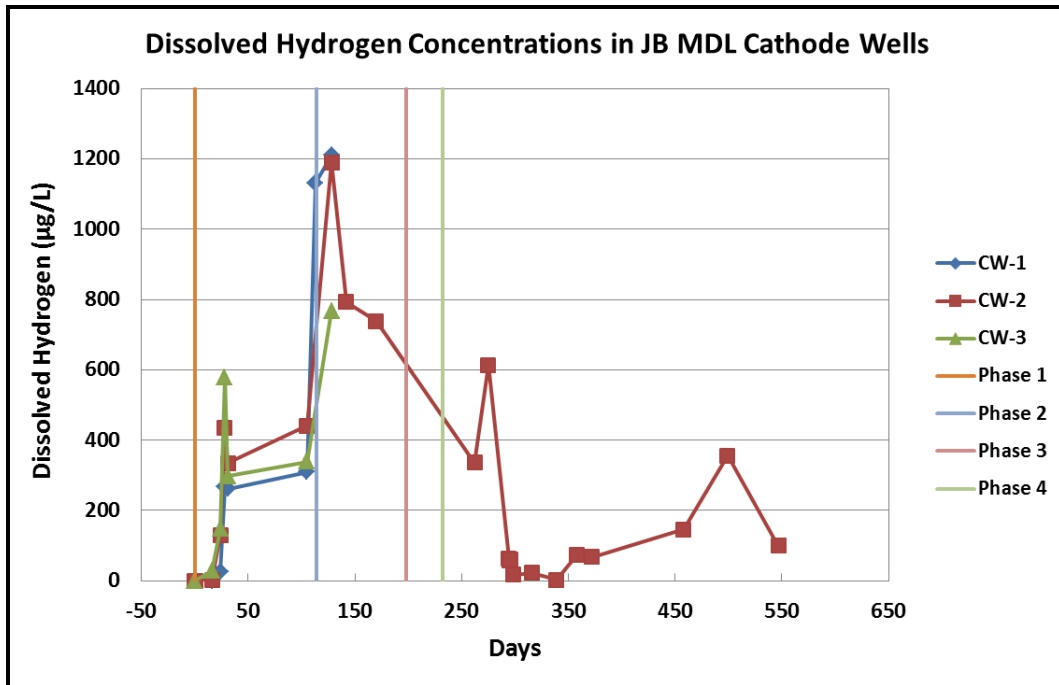


Figure 5.38. Dissolved Hydrogen Concentrations Measured in Cathode Wells.

Cathodes CW-1 and CW-3 were taken off line during operation of the small recirculation system (Phase 4).

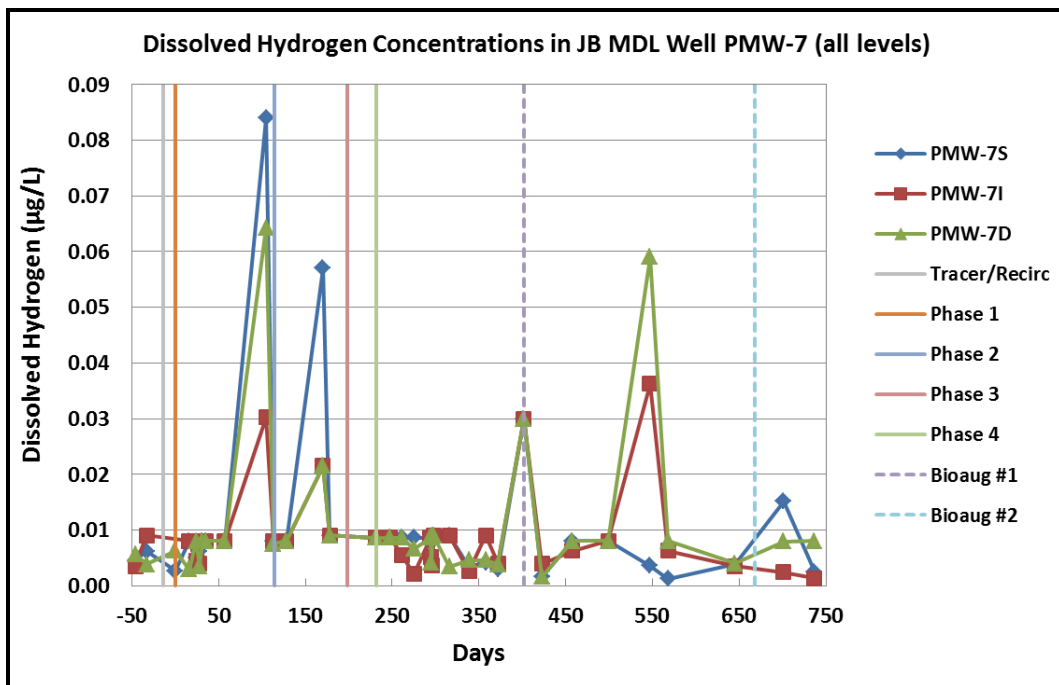


Figure 5.39. Dissolved Hydrogen Concentrations Measured in MLS Monitoring Well PMW-7

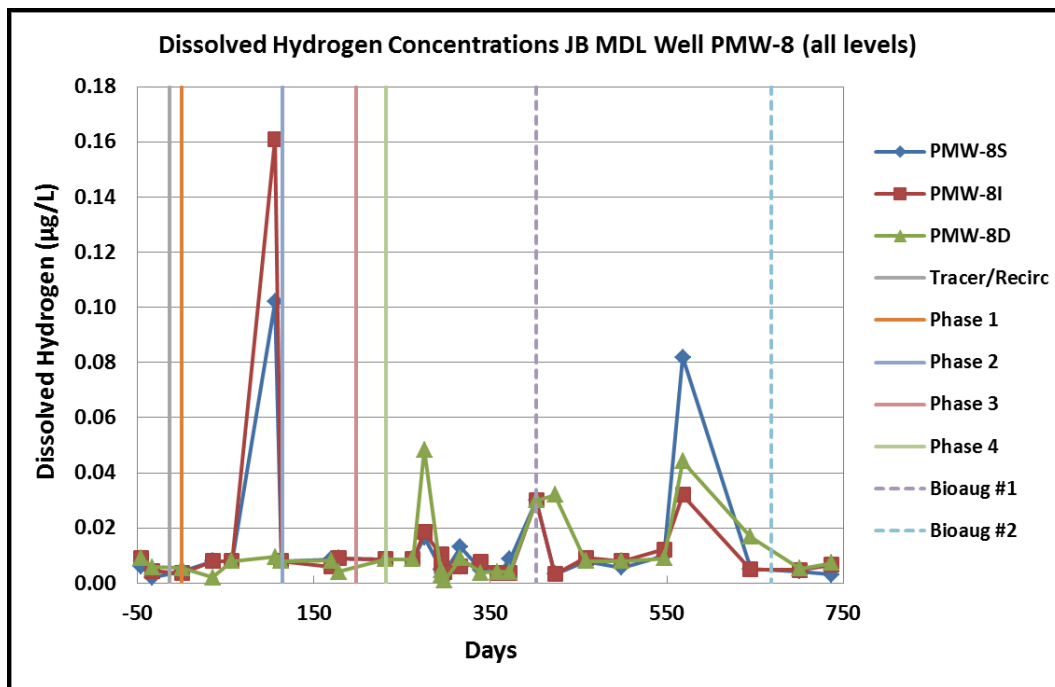


Figure 5.40. Dissolved Hydrogen Concentrations Measured in MLS Monitoring Well PMW-8

5.7.4 Oxidation-Reduction Potential

The ORP measured at the MLS monitoring wells PMW-7 and PMW-8 fluctuated significantly during the demonstration, but did occasionally reach levels sufficient to support complete reductive dechlorination of TCE (< -100 mV) (**Figures 5.41 and 5.42**). However, the ORP conditions were unfavorable through much of the demonstration. The ORP temporarily decreased to desirable levels in all of the PMW-7 and PMW-8 sample intervals immediately after both bioaugmentation injections. However, the ORP slowly increased again after both injections. The data show that we were unable to maintain target ORP levels within the treatment zone during most of the demonstration. While not presented, the DO concentrations measured in MLS wells PMW-7 and PMW-8 were typically below 1.0 mg/L during Phase 4 of the demonstration. Baseline DO concentrations at these wells were between ~0.5 and 2.5 mg/L.

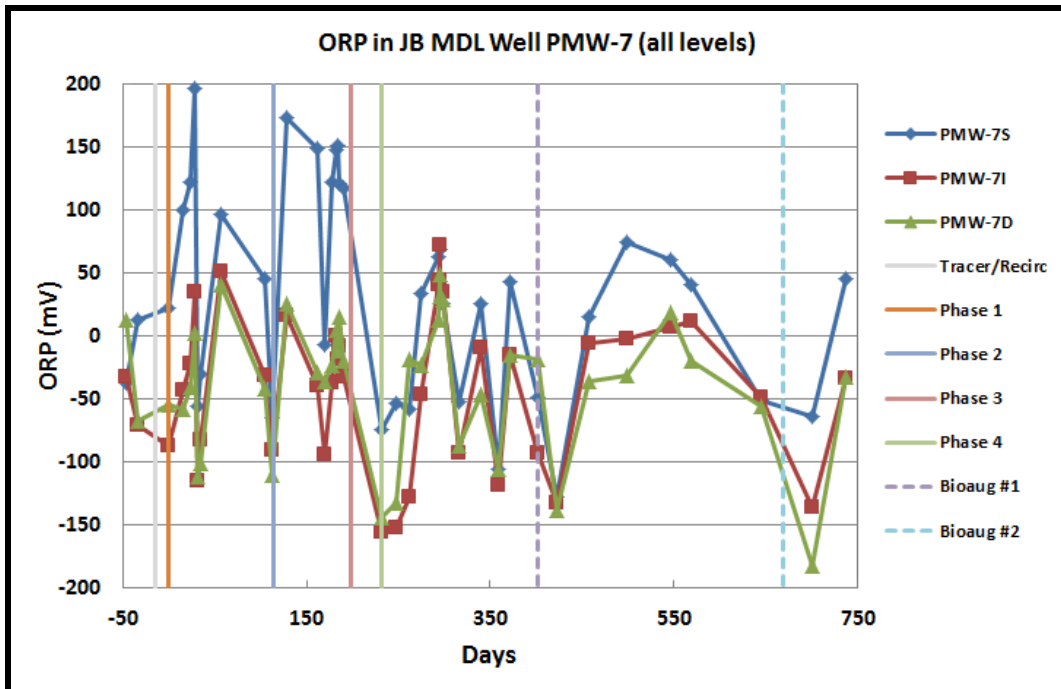


Figure 5.41. ORP Measurements in MLS Monitoring Well PMW-7

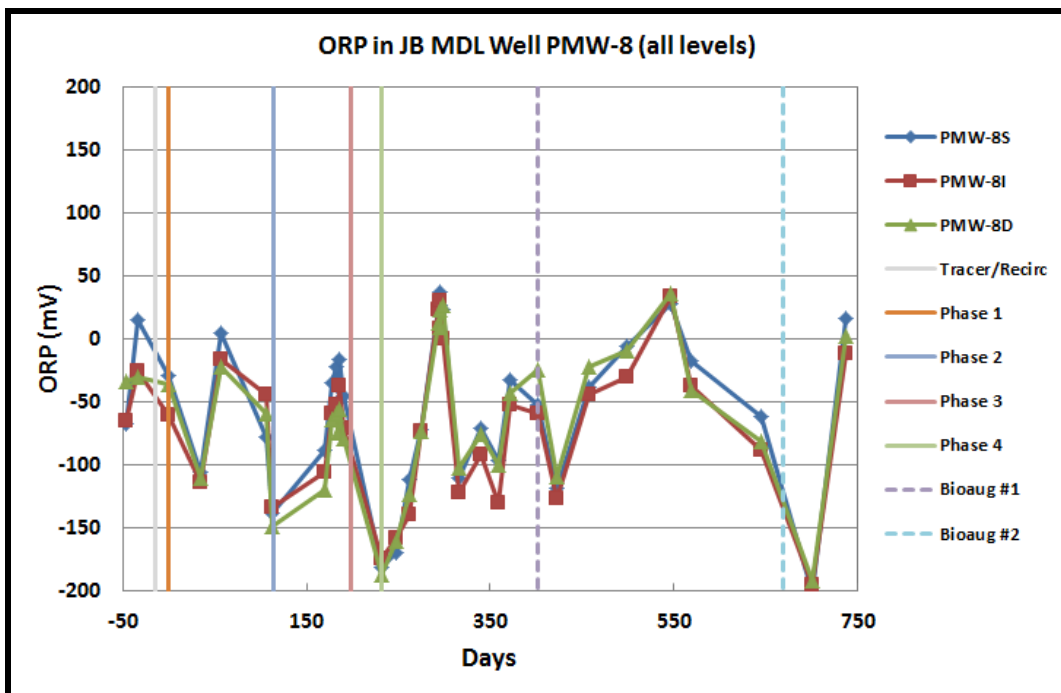


Figure 5.42. ORP Measurements in MLS Monitoring Well PMW-8

5.7.5 Electron Acceptor Concentrations

Factors that could have limited distribution of H_2 *in situ* include competition for H_2 by microorganisms that used other electron acceptors. In situ competition for H_2 has been well documented (Löffler, et al.,1999). Competing electron acceptor processes could have included iron reduction, manganese reduction, sulfate reduction, and methanogenesis. Homoacetogenesis also could have contributed to competition for the produced H_2 (Yang and McCarty, 1998).

During Phase 4 of operation, dissolved iron concentrations in MLS wells PMW-7 and PMW-8 did not exhibit a consistent concentration increase, and some of the measured differences in Fe concentrations may have been due to mixing (**Figure 5.43**). In particular, during the initial operation of the Phase 4 recirculation system, oxygenated water was continuously pumped from well AW-2, which had previously been used as an anode well. The influence of this water on Fe concentrations is not certain, but it is likely that some Fe oxidation may have occurred thereby leading to uncertainty about the role of Fe reduction in H_2 consumption.

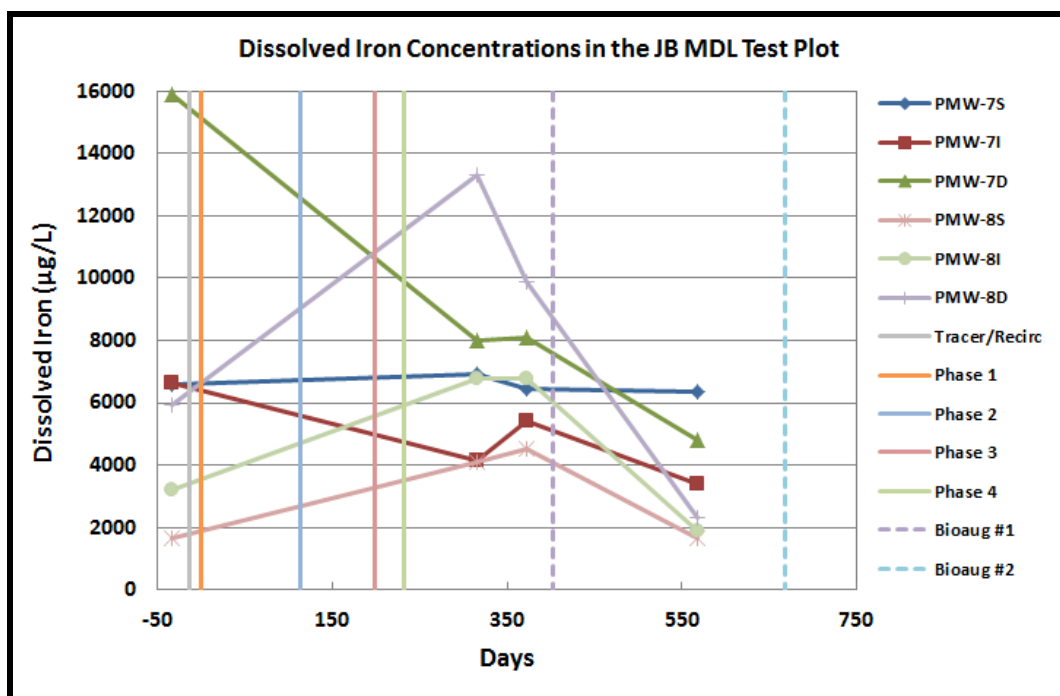


Figure 5.43. Dissolved Iron Concentrations in MLS Wells PMW-7 and PMW-8

Unlike dissolved Fe, increases in dissolved Mn concentrations appeared more conclusive within three of the monitoring intervals (PMW-7I, PMW-8S, and PMW-8I), with dissolved Mn concentrations being about three times greater at the end of the demonstration than during baseline sampling (**Figure 5.44**). However, Mn concentrations were 1 to 2 orders of magnitude less than Fe concentrations. Similar to the dissolved Fe results, the amount of manganese reduction that could be attributable to biological activity and consumption of the produced H_2 could not be confirmed.

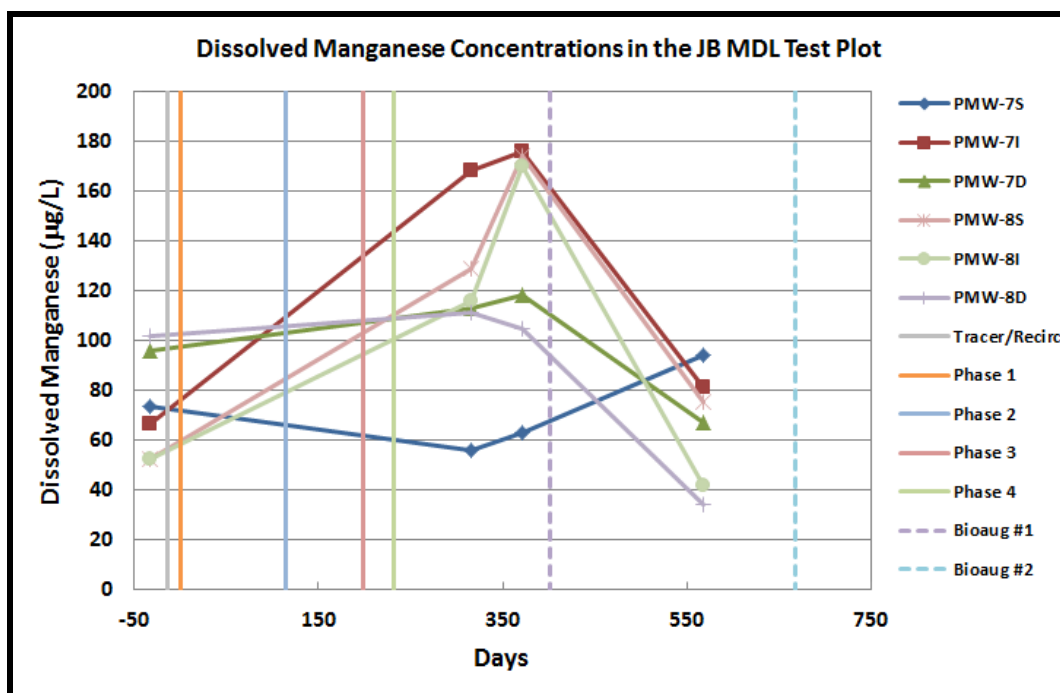


Figure 5.44. Dissolved Manganese Concentrations in MLS Wells PMW-7 and PMW-8

Sulfate reduction could not be ruled out as a sink for H_2 produced during this demonstration. With the exception of PMW-7S, sulfate concentrations at MLS wells PMW-7 and PMW-8 (**Figure 5.45**) decreased significantly (between 60 and 85 percent) during the course of the demonstration, and these reductions were likely due to biological sulfate reduction. During Phase 4 of the demonstration sulfate concentrations in PMW-7D, which was the portion of the aquifer with the greatest cVOC degradation, were reduced by approximately 40 mg/L (0.42 mM). Because 4 moles of H_2 are needed to reduce 1 mole of sulfate to sulfide ($SO_4^{2-} + 4H_2 + H^+ \rightarrow HS^{1-} + 4H_2O$), this represents a potential H_2 consumption of 1.7 mmole per liter of groundwater (i.e., 3.4 mg H_2 /L). Maximum potential H_2 production, based on a current of 250 mA was about 100 mmoles/day. Thus, sulfate reduction may have been a significant potential sink for the produced H_2 . The advantage of sulfate reduction in an acidic aquifer is that the process does consume some acidity (i.e., H^+).

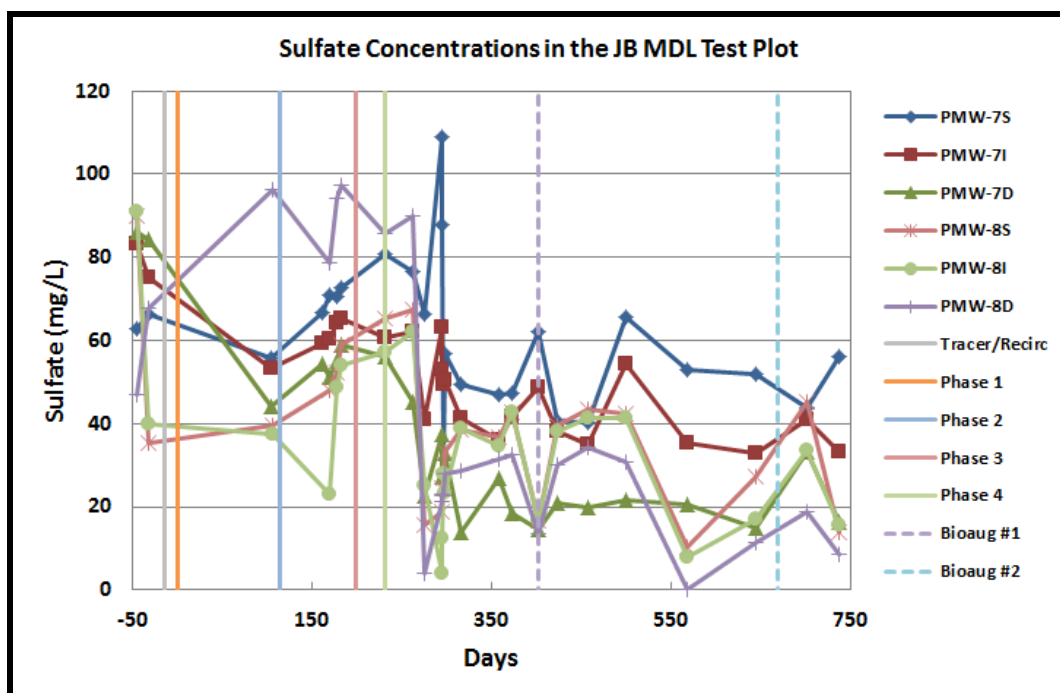


Figure 5.45. Sulfate Concentrations in MLS Wells PMW-7 and PMW-8

5.7.6 cVOC Treatment

Based on laboratory studies performed at the beginning of the project (**Section 5.3.2**), a microbial population capable of complete dechlorination of TCE did not exist at the site, presumably because of the low natural pH. Consequently, bioaugmentation injections with the SDC-9 dechlorination culture were performed at well CW-2 on days 402 and 668 of the demonstration (**Section 5.5.4**).

With the exception of well PMW-7D, the concentration of TCE decreased notably in treatment zone monitoring MLS wells PMW-7 and PMW-8 during the demonstration (**Figure 5.46**). These decreases ranged from 31 percent (PMW-7S) to 89 percent (PMW-8I). As shown on **Figure 5.47**, notable transient increases in cDCE concentrations were observed in the treatment zone monitoring wells during the last ~100 days of the demonstration. Increases up to an order of magnitude were observed during this period. These data suggest that partial dechlorination of TCE was occurring within the treatment zone. However, the lack of observed vinyl chloride (not presented) and/or ethene concentrations (**Figure 5.48**) at these wells indicated that complete reductive dechlorination was not occurring at a significant rate. This is likely due (at least partially) to the sub-optimal pH and ORP levels that had been achieved within the treatment zone.

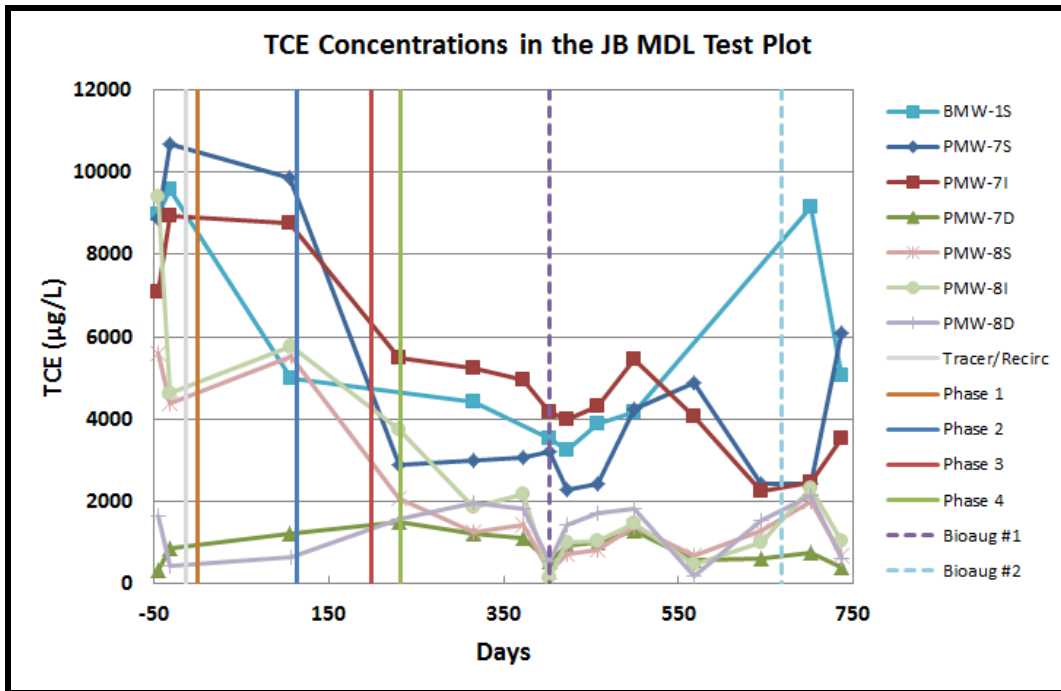


Figure 5.46. TCE Concentrations in MLS Wells PMW-7 and PMW-8, and Background Well BMW-1S

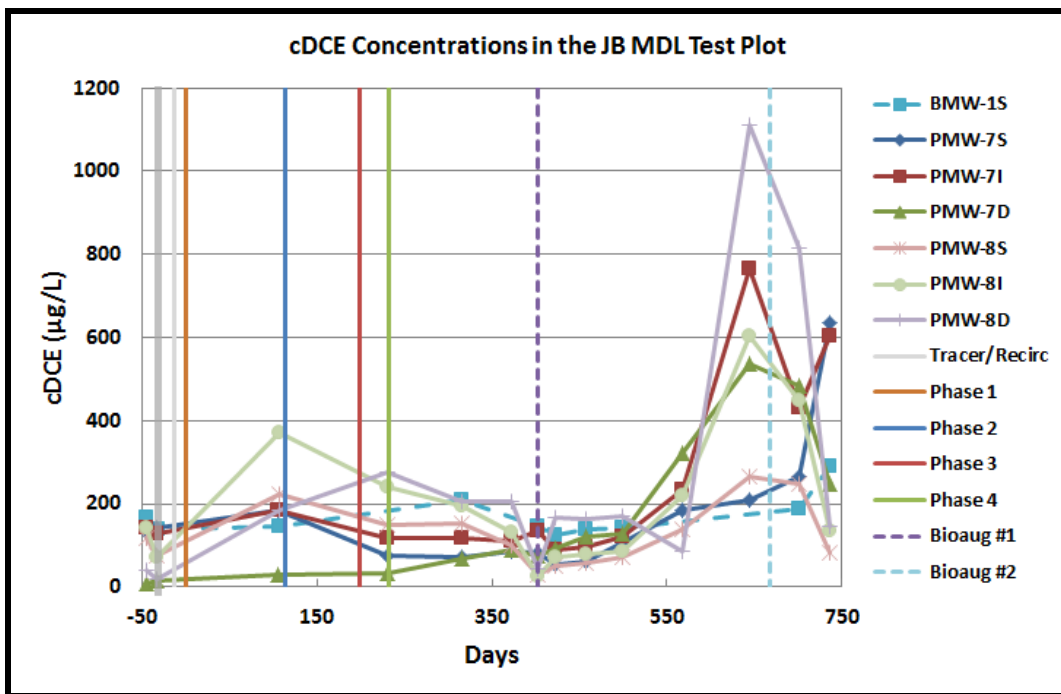


Figure 5.47. cDCE Concentrations in MLS Wells PMW-7 and PMW-8, and Background Well BMW-1S

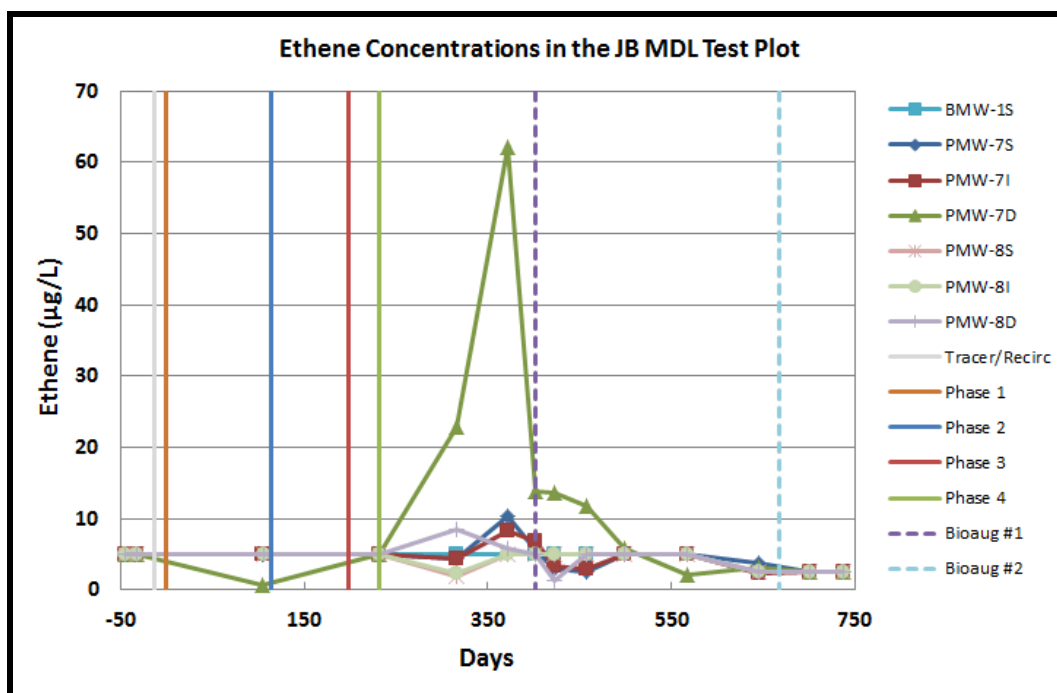


Figure 5.48. Ethene Concentrations in MLS Wells PMW-7 and PMW-8, and Background Well BMW-1S

5.7.7 DHC Distribution and Growth

Groundwater samples for DHC quantification (via qPCR) were collected during Phase 4 from MLS monitoring wells PMW-7 and PMW-8 within the small recirculation loop immediately prior to and approximately two months after the first bioaugmentation event (**Table 5.16**). Sample analysis and quantities are summarized in **Sections 5.6.2** and **5.6.3**, respectively, and qPCR results are provided in **Table 5.17**. Some of the DHC data collecting prior to bioaugmentation showed what we believe to be false positives due to cross-contamination from the ambient and ubiquitous presence of SDC-9 from our fermentation production center, which is located within the same facility as our analytical lab. DHC data collected after the first bioaugmentation injection during Phase 4 indicated a lack of distribution and growth of the bioaugmentation culture during the demonstration.

Table 5.17. Enumeration of *Dehalococcoides* sp. Bacteria in Groundwater during Phase 4

Well	Day 402 DHC/L	Day 458 (DHC/L
PMW-7S	2.49E+05*	3.20E+01 U
PMW-7I	9.50E+03*	3.20E+01 U
PMW-7D	1.02E+03*	3.20E+01 U
PMW-8S	3.40E+01 U	3.20E+01 U
PMW-8I	3.40E+01 U	ND
PMW-8D	1.54E+05*	3.20E+01 U

U - The compound was not detected at the indicated concentration.

ND - No data.

DHC/L - *Dehalococcoides* cells per liter

*Positive results are believed to be the result of cross-contamination from the CB&I Fermentation facility.

5.7.8 PRT System Operation

As described in **Section 5.4.9**, the PRT system was completely powered via an off-the-grid solar power system. The system initially consisted of two 85 watt photovoltaic solar panels, and two deep discharge 80 amp hour 12V batteries. However, this power source was determined to be insufficient to provide continuous 24-hour operation when we began running the system at the maximum voltage (16V) and amperage (>300 mA) that the PRT panel was capable of providing. Site inspections during the first two weeks of Phase 1 indicated that the batteries would at times drain during the evening to the point where the PRT system would shut down. The addition of two additional solar panels and two more batteries to the PRT system were sufficient to provide continuous 24-hour operation >95 percent of the time. Once the solar power system was upgraded, the PRT system operated as designed during the remainder of the demonstration. The operational current at each of the cathodes was typically measured to be within the range of 250 mA to 350 mA during weekly site visits.

The PRT system was designed so that the polarity of the proton reduction system could be periodically switched (i.e., the cathodes become anodes, and the anodes become cathodes) to control pH increases at the cathode wells, or to minimize fouling of the mixed metal oxide electrodes. We did not reverse the polarity during the demonstration, as the system was unable to sufficiently increase pH and lower ORP within the treatment zone. Switching the polarity would have generated low pH, oxygenated water within and around the cathode wells during the demonstration, which, on even a short-term basis, would likely have negatively impacted the aquifer geochemistry.

As shown in the photographs in **Figure 5.49**, iron oxide deposits were observed on the electrode ribbon removed from the anode wells, and mineral deposits (likely calcite) were observed on the electrode ribbon removed from the cathode wells. The majority of these deposits were easily removed from the mesh ribbon using water and a scrub brush. There was no corrosion observed on the electrode surface once the deposits were removed. It is likely that the buildup of these deposits could be mitigated if the polarity of the PRT system were occasionally reversed for short periods of time.



Figure 5.49. Photographs of Electrode Fouling.

Iron oxide deposits on the electrode from an anode well (left) and mineral deposits (likely calcite) on the electrode from a cathode well.

6.0 PERFORMANCE ASSESSMENT

Performance objectives were established for this demonstration to provide a basis for evaluating the use of solar-powered PRT to increase the pH of a naturally-acidic, TCE-contaminated aquifer at JB MDL, and to use the H_2 produced by proton reduction to support TCE dechlorination by dechlorinating bacteria. Performance criteria were selected based on factors that would likely be considered when bringing the proposed technology to full-scale application. The performance objectives are provided in **Table 3.1**, and discussed in **Sections 3.1 to 3.10** in this document. The data for each given objective are provided in **Section 5.7** and **Appendix D**.

The main objective of the demonstration was to effect sustainable aquifer neutralization and contaminant degradation. As summarized in **Sections 3.0** and **5.7**, not all of the critical performance objectives for this demonstration were achieved. The following subsections provide a summary and assessment of the data supporting performance objectives.

6.1 INCREASE AND MAINTAIN NEUTRAL AQUIFER PH

In order for successful bioremediation to occur, the groundwater pH in the treatment zone must be increased to a pH of approximately 6 or greater. In this demonstration, the objective was to achieve this increase in pH via the use of electrodes inserted into the subsurface to consume H^+ and produce OH^- .

In order to evaluate this performance objective, groundwater samples were collected and analyzed on site for pH during two baseline sampling events, and forty times during the Period of Operation, which continued for approximately 2 years. Data collected during the Period of Operation was compared to the data collected during baseline sampling and system startup to determine the increase in pH during operation of the proton reduction system. For this performance objective to be considered successful, the pH of the groundwater in test plot monitoring wells immediately downgradient of the cathodes (i.e. treatment zone) needed to be increased and maintained to between 6 and 8 SUs.

As detailed in **Section 5.7.2**, no significant increases in aquifer pH were observed at the monitoring wells located downgradient of the cathodes during Phase 1 through Phase 3 of the demonstration. Upon initiating operation of a small recirculation system on day 233 (Phase 4), groundwater pH at some of the MLS well intervals (particularly PMW-7S) began to increase, and pH levels near pH 6 were achieved. Because pH is a log scale, the increase in pH at PMW-7S indicated an approximately 10-fold reduction in acidity at this location. However, consistent and significant pH increases throughout the designed treatment zone were not observed during Phase 4 of the demonstration. It is likely that the degree of electrolysis occurring at the cathode during Phase 4 was not sufficient to substantially increase the pH of acidic groundwater being continually re-circulated into the injection/cathode well, as the high pH levels observed in the electrode/cathode wells during Phase 1-3 of operation were not observed during Phase 4.

While increases in groundwater pH levels at or above 6 SUs were observed at some of the MLS well intervals during the demonstration, the PRT system (as configured) was unable to maintain a consistent pH between 6.0 and 8.0 SUs within the designed treatment area. Therefore, this performance metric was only partially achieved.

6.2 PRODUCTION OF H₂ AT THE CATHODE

The primary goal of this performance objective was to confirm that H₂ was being generated at the cathodes. In order to evaluate H₂ production at the cathodes, groundwater samples were collected from the cathode wells and analyzed for dissolved H₂ immediately prior to PRT system startup, and numerous times during the 2-year Period of Operation. These data were also used to determine the concentrations of H₂ being generated at the electrode/cathode wells.

This performance objective was to be considered successful if groundwater dissolved H₂ concentrations of >130 µg/L (approximately 10 percent of solubility) were measured at each of the three cathode wells. As detailed in **Section 5.7.3**, once operation of the proton reduction system was optimized, H₂ concentrations in the demonstration plot cathode wells consistently exceeded 160 µg/L and reached concentrations up to approximately 1,200 µg/L (>90 percent of solubility). H₂ concentrations in the cathode well groundwater remained high during Phases 1 and 2 of the demonstration. During Phase 3 and 4 of the demonstration, H₂ concentrations in the cathode well(s) decreased because the addition of extracted water to the cathode wells (i.e., injection wells) continually diluted H₂ concentrations and forced the H₂-containing groundwater into the aquifer.

During operating phases where groundwater was not being re-injected in to cathode wells (Phases 1 and 2), dissolved H₂ concentrations of >130 µg/L were consistently measured in the groundwater within the three cathode wells. Therefore, this performance metric was achieved.

6.3 DISTRIBUTION OF H₂ TO 1 METER DOWNGRADIENT OF THE CATHODE

In order for H₂ to be effective as an electron donor to support biological reductive dechlorination, it must be adequately distributed throughout the treatment zone. The goal of this performance objective was to confirm that H₂ was present in adequate concentrations at least 1 meter downgradient of the cathodes, where it was formed. The extent to which dissolved H₂ migrates downgradient of the cathode is largely dependent upon the groundwater velocity and the site-specific H₂ utilization rate. Additionally, we attempted to evaluate the potential for generation of H₂ between inserted electrodes via the electrolysis of water on clay surfaces that may act as microcapacitors (as discussed in **Section 2.1.2**). The data collected were used to determine the concentrations of H₂ at the MLS monitoring wells installed between the electrodes and throughout the test plots, and to establish whether the H₂ concentrations were adequate for reductive dechlorination (>4 ng/L, as discussed in **Section 2.1.1**).

This performance objective was to be considered successful if groundwater H₂ concentrations of >0.010 µg/L (2.5 times the concentration required to support reductive dechlorination) were present at least 1 meter downgradient of the cathode wells. As discussed in **Section 5.7.3**, H₂ concentrations occasionally exceeded 0.010 µg/L at the MLS wells closest to the cathode wells during the demonstration. However, H₂ concentrations were more typically below the detection level (<0.008 µg/L) at these wells. Furthermore, dissolved H₂ concentrations at the two MLS wells monitored during Phase 4 of the demonstration were typically below 0.010 µg/L. Considering H₂ concentrations at well CW-2 (cathode/injection well) were typically >50 µg/L during this Phase, this suggests that there was a substantial sink for hydrogen between CW-2 (cathode/injection well) and the MLS wells (located 2.5 ft and 5.0 ft away, and within the recirculation loop). As previously discussed, possible sinks for H₂ include Fe and Mn reduction, sulfate reduction, acetogenesis, and methanogenesis, as well as dechlorination of TCE.

While occasional detections of H₂ concentrations of >0.010 µg/L were observed at some of the MLS well intervals during the demonstration, H₂ was not consistently observed at or above the target concentration within the designed treatment area. Therefore, this performance metric was not achieved.

6.4 REDUCTION OF TCE AND CIS-DCE IN THE TEST PLOT

The main contaminants of concern in the JB MDL groundwater plume at Area SS-36 are TCE and *cis*-DCE. In order to evaluate treatment of cVOCs in the test plot, groundwater samples were collected and analyzed for VOCs during two baseline sampling events and 12 times during the 2-year Period of Operation. The data collected were used to determine the extent of TCE and *cis*-DCE reduction and daughter product formation in the test plot.

This performance objective was to be considered successful if TCE and *cis*-DCE concentrations in the test plot monitoring wells were reduced by >95%. As discussed in **Section 5.7.6**, measureable reductions in TCE concentrations, ranging between 31 and 89 percent, were observed at 5 of the 6 MLS well intervals monitored throughout the course of the demonstration. Notable transient increases in cDCE concentrations were observed in the treatment zone monitoring wells during the last ~100 days of the demonstration, with increases of up to an order of magnitude detected. These data suggest that partial dechlorination of TCE was occurring within the treatment zone. However, the lack of observed vinyl chloride and/or ethene concentrations at these wells indicated that complete reductive dechlorination was not occurring at a significant rate. This was likely due (at least partially) to the sub-optimal pH and ORP levels that had been achieved within the treatment zone. While significant reduction in TCE concentrations were achieved, complete reductive dechlorination was not observed, and reductions of TCE and *cis*-DCE by >95% were not achieved.

6.5 COMPLETE AND PROLONGED BIODEGRADATION OF TCE TO ETHENE

The goal of this performance objective was to achieve sustainable TCE and *cis*-DCE biodegradation *in situ* for a minimum of eight months, and to demonstrate that these compounds were reduced completely to ethene. In order to evaluate prolonged treatment of cVOCs in the test plot, groundwater samples were collected and analyzed for VOCs and reduced gases during two baseline sampling events and 12 times during the 2-year Period of Operation. These data collected was used to establish the extent of TCE reduction and daughter product formation in the test plot.

This performance objective was to be considered successful if reductive dechlorination of TCE and *cis*-DCE were prolonged throughout the Period of Operation, and if TCE degradation proceeded completely to ethene without stalling at *cis*-DCE or VC. It was expected that *cis*-DCE and VC would be produced as transient intermediates of TCE degradation and also would be rapidly degraded. As discussed in **Section 5.7.6**, while some substantial transient increases in *cis*-DCE were observed at some of the test plot MLS wells, only traces of vinyl chloride were observed. Furthermore, while some low levels of ethene were observed, the source of the measured ethene is not certain. These data suggest that partial dechlorination of TCE was occurring during the demonstration, and that complete reductive dechlorination was limited. Therefore, this performance metric was not achieved.

6.6 DISTRIBUTION AND GROWTH OF ADDED DHC

The goal of this performance objective was to achieve adequate distribution and growth of bioaugmented DHC downgradient of the cathodes and throughout the test plot treatment zone through stimulation with H₂ produced by the proton reduction system. In order to evaluate these objectives, pre-bioaugmentation and post-bioaugmentation sampling events were performed in which groundwater samples were obtained from select wells and analyzed using quantitative polymerase chain reaction (qPCR) to determine DHC groundwater concentrations. The data collected was used to determine the distribution and growth of DHC within the test plot.

This performance objective was to be considered successful if qPCR data indicated that DHC were distributed downgradient of the injection point, and that DHC concentrations increases *in situ* to $>1.0 \times 10^7$ cells/liter as cVOCs were reduced. As discussed in **Section 5.7.7**, DHC data collected during the demonstration indicated a lack of distribution and growth of the bioaugmentation culture during the demonstration.

6.7 ELECTRODE STABILITY FOR >1 YEAR

In order for the treatment system to be successful, consistent and sustained proton reduction and production of H₂ at the cathode needed to be achieved. This required that the electrodes perform continuously, without measureable loss in performance. The collection of system operating voltages and currents, and visual observations of the electrode material at multiple time points throughout the demonstration was required to evaluate this performance objective. System operating parameters were recorded at least twice per month, and the electrodes were removed from the wells for inspection approximately once every six months. The data collected was used to determine the operating efficiency of the electrodes during the demonstration.

This performance objective was to be considered successful if the electrodes operated effectively, without measurable loss of performance for >1 year. Additionally, electrode corrosion observed during inspections must be minimal. Regular system operation measurements collected during the demonstration indicated that there was no significant decrease in electrode performance (i.e. loss of current at a given voltage) during two years of operation. Also, as discussed in **Section 5.7.8**, some fouling of the cathodes was observed during inspections. However, this did not appear to significantly impact electrode performance. Therefore, this performance metric was achieved.

6.8 SYSTEM RELIABILITY AND EASE OF OPERATION

The goal of this performance objective was to assess and maximize the reliability and ease of operation of the solar-powered proton reduction system. This performance objective was qualitative, and thus was evaluated using the observations of field personnel and project management. These include logged data collected from the solar power system, and system operating parameters recorded during regular site inspections.

This performance objective was to be considered successful if the solar-powered proton reduction system operated continually (i.e., for a minimum of 12 months) with minimal downtime and supervision (i.e., less than 8 hours of manpower per month required to successfully operate the system). As discussed in **Section 5.7.8**, field observations and system

operating records indicated that the system operated >95% of the time over a 2 year period, with minimal O&M required. Therefore, this performance metric was achieved.

6.9 SUSTAINED SOLAR OUTPUT TO OPERATE THE PRT SYSTEM

The goal of this performance objective was to assess and maximize the reliability and ease of operation of the off-the-grid solar-power system that powered the proton reduction system. This performance objective is qualitative, and thus was evaluated by using the observations of field personnel and project management. These include logged data collected from the solar power system, and system operating parameters recorded during regular site inspections.

This performance objective was to be considered successful if the electrical output derived from the solar power was sufficient to power the proton reduction system for the course of the demonstration (i.e., a minimum of 12 months) with no additional external power required. As discussed in **Section 5.7.8**, additional solar panels and batteries were added to the solar power system near the beginning of the demonstration to provide consistent 24-hour operation of the PRT system. Field observations and system operating records indicate that the solar power system operated >95% of the time over a 2 year period, with minimal O&M required. Therefore, this performance metric was achieved.

6.10 NO SAFETY HAZARDS OR INCIDENTS DURING SYSTEM OPERATION

The goal of this performance objective was to assess and maximize the safety of operating the solar-power PRT system. This performance objective is qualitative, and thus was evaluated by using the observations of field personnel and project management. These include safety observations and measurements made during regular site inspections and field activities.

This performance objective was to be considered successful if there were no observed or recorded safety incidents or hazardous conditions during system operation and monitoring over the course of the demonstration. Safety observations and records indicated that there were no safety incidents or injuries that occurred during the demonstration. A build-up of H₂ gas was measured in the sealed cathode wells during early operation of the PRT system. H₂ buildup was mitigated by opening the valves on the cathode well heads, and drilling holes in the lids of the well vaults to allow H₂ to dissipate from the wells. No explosive conditions were measured (via combustible gas meter) during the demonstration. Therefore, this performance metric was achieved.

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7.0 COST ANALYSIS

7.1 COST MODEL

In order to evaluate the cost of a potential full-scale PRT system, and compare it against other remedial approaches, costs associated with various aspects of the demonstration were tracked throughout the course of the project. **Table 7.1** summarizes the various cost elements and total cost of the demonstration project. The costs have been grouped by categories as recommended in the Federal Remediation Technologies Roundtable Guide to Documenting Cost and Performance for Remediation Projects (FRTR, 1998). Many of the costs shown on this table are a product of the innovative and technology validation aspects of this project, and would not be applicable to a typical site application. Therefore, a separate “discounted costs” column that excludes or appropriately discounts these costs has been included in **Table 7.1** to provide a cost estimate for implementing this technology at the same scale as the demonstration (i.e., pilot scale).

Costs associated with the demonstration were tracked from March 2010 to September 2015. The total cost of the demonstration was \$1,031,800 which included \$339,487 in capital costs, \$209,445 in operation and maintenance (O&M) costs, and \$482,868 in demonstration-specific costs (cost related to ESTCP requirements, site selection and characterization).

7.1.1 Capital Costs

Capital costs (primarily system design and installation) accounted for \$339,487 (or 33 percent) of the total demonstration costs. As indicated in **Table 7.1**, these costs exceed what would be expected during a typical remediation project due partially to the large number of performance monitoring wells (12 multi-level wells) installed within the relatively small (40' x 40') demonstration area.

7.1.2 O&M Costs

O&M costs accounted for \$209,425 (or 20 percent) of the total demonstration cost. These costs consisted primarily of groundwater monitoring (including analytical), system O&M, and reporting costs. System O&M costs were \$32,100, or 3 percent of total demonstration costs. Extensive performance monitoring activities were conducted to effectively validate this technology; including 2 baseline, 12 performance monitoring, 16 dissolved hydrogen, and 13 tracer testing groundwater sampling events.

7.1.3 Demonstration-Specific Costs

Other demonstration-specific costs (those costs not expected to be incurred during non-research-oriented remediation projects) accounted for \$482,900 (or 47 percent) of the total demonstration cost. These costs included site selection, laboratory treatability studies, laboratory buffer testing, laboratory electrode testing, hydrogeologic testing, tracer tests, ESTCP demonstration reporting and meeting (IPR) requirements, and preparation of extensive technical and cost and performance reports.

Table 7.1. Demonstration Cost Components

Cost Element	Details	Tracked Demonstration Costs	Discounted Costs ¹
CAPITAL COSTS			
Groundwater Modeling	Labor	\$8,265	\$4,132
System Design	Labor	\$32,661	\$16,331
Well Installation, Development & Surveying ²	Labor	\$51,978	\$25,989
	Materials	\$4,888	\$2,444
	Subcontracts (driller/surveyor)	\$67,129	\$33,565
System Installation (electrical service, control panel, trenching, system materials)	Labor	\$88,559	\$88,559
	Equipment & Materials	\$83,020	\$83,020
	Subcontracts	\$0	\$0
Bioaugmentation	Labor and Materials	\$2,987	\$2,987
Subtotal		\$339,487	\$257,027
OPERATION AND MAINTENANCE COSTS			
Groundwater Sampling	Labor	\$73,384	\$36,692
	Materials	\$5,001	\$2,500
Analytical	In-House Labor	\$88,219	\$44,110
	Outside Labs	\$4,878	\$2,439
System O&M (including testing & start-up)	Labor	\$32,110	\$16,055
	Materials	\$0	\$0
Reporting & Data Management	Labor	\$4,280	\$4,280
Travel		\$1,573	\$1,573
Subtotal		\$209,445	\$107,649
OTHER TECHNOLOGY-SPECIFIC COSTS			
Site Selection	Labor	\$33,317	\$0
Site Characterization (drilling investigation, depth-dependent sampling, slug tests, pump tests)	Labor (including in-house analytical)	\$48,749	\$0
	Materials	\$0	\$0
	Subcontractor (driller)	\$8,900	\$0
Treatability Studies and Column Testing	Labor (including in-house analytical)	\$55,120	\$0
	Outside Lab	\$0	\$0
Lab Buffer Testing	Labor (including in-house analytical)	\$21,072	\$0
Lab Electrode Testing	Labor (including in-house analytical)	\$58,677	\$0
Hydrogeologic Testing	Labor & Travel	\$10,249	\$0
Tracer Testing	Labor & Travel	\$21,108	\$0
IPR Meeting & Reporting	Labor & Travel	\$31,335	\$0
Monthly and Quarterly Reports	Labor & Travel	\$33,081	\$0
Technology Transfer (presentations, papers)	Labor & Travel	\$33,196	\$0
Demonstration Plan/Work Plan	Labor	\$42,104	\$21,052
Final Report	Labor	\$65,732	\$32,866
Cost and Performance Report	Labor	\$20,225	\$0
Subtotal		\$482,868	\$53,918
TOTAL COSTS		\$1,031,800	\$418,594

Notes:

¹ Discounted costs are defined as estimated costs to implement this technology at the same scale as the demonstration. These costs do not include the technology validation aspects of this ESTCP demonstrations, such as site selection, treatability studies, extensive groundwater sampling, ESTCP demonstration reporting and meeting (IPR) requirements, and preparation of technical and cost and performance reports.

7.2 COST DRIVERS

7.2.1 General Considerations

The expected cost drivers for installation and operation of a PRT system, and those that will determine the cost/selection of this technology over other options include the following:

- Depth of the plume below ground surface;
- Width, length, and thickness of the plume;
- Aquifer lithology and hydrogeology;
- Regulatory considerations concerning secondary groundwater impacts (i.e. metals mobilization, sulfate reduction, etc.);
- Length of time for clean-up (e.g., necessity for accelerated clean-up);
- The presence of indigenous bacteria capable of degrading chlorinated VOCs;
- Concentrations of contaminants and alternate electron acceptors (e.g., NO_3^- , SO_4^{2-} and O_2); and
- Presence of co-contaminants.

7.2.2 Competing Treatment Technologies

Other technologies that have been proven to treat chlorinated ethenes in groundwater to below regulatory levels at the field scale include:

1. Pump and treat (P&T) with air stripping and/or carbon adsorption;
2. Zero valent iron permeable reactive barriers (ZVI PRBs);,
3. Biostimulation with or without bioaugmentation;
4. In-Situ Chemical Oxidation (ISCO); and
5. Air sparge/soil vapor extraction.

Pump and treat technologies provide capture of contaminated groundwater, and above-ground treatment of the extracted water prior to discharge or re-injection into the subsurface. While these systems can provide protection to downgradient receptors if designed properly, they are inefficient at removing contaminant mass from a plume and/or source zone, and often require operation for decades, leading to high overall costs.

ZVI PRBs and biobarriers treat contaminated groundwater as it flows through the wall/barrier. While these approaches can provide protection to downgradient receptors, they are even less effective than P&T at removing contaminant mass from the plume and/or source zone. They may also require regular replacement as the materials (ZVI and organic substrate) are used up or begin to clog, leading to contaminated groundwater flowing around or beneath the wall/barrier.

Bioremediation (active, passive, or semi-passive approaches) can be utilized to treat source areas and diffuse plumes or as a barrier to protect downgradient receptors, whereas the two technologies discussed above (P&T and ZVI PRBs) are typically used as barriers to protect downgradient receptors.

ISCO is most often used in well-defined source areas of limited extent rather than as a barrier application, due to the high cost of chemicals. Air sparging is used to drive volatile contaminant into the vapor phase and into the unsaturated zone. Soil Vapor Extraction (SVE) is often required to remove and treat the volatile contaminants to prevent exposure to vapors.

The plume characteristics and those of the local aquifer will play an important role in the cost and applicability of the above technologies for remediation of VOC-contaminated groundwater. For shallow groundwater plumes (< 50 ft bgs), passive *in situ* options, such as installation of a PRB consisting of either injection well or direct-push applied slow-release substrates (like EVO) are likely to be cost effective options, providing the selected substrate(s) have been shown to stimulate indigenous microorganisms capable of degrading target contaminants at the treatment site. ZVI PRBs may also provide cost-effective options for passively treating contaminants at the downgradient edge of groundwater plumes. These passive systems require little O&M after installation, and have the ability to prevent plumes from spreading or leaving a site. However, they may be less suitable at sites where concerns about secondary groundwater contaminants (e.g. reduction and mobilization of Fe, Mn, and As, sulfide from sulfate reduction, etc.) exist. Additionally, trench-installed barrier technologies may require regular ZVI replacement (ZVI PRBs) to remain effective.

For deeper plumes (e.g. >50 ft. bgs) or those that are large or very thick, passive approaches are often not technically feasible and are cost-prohibitive (e.g., injecting passive substrates at closely spaced intervals to >50 ft bgs). Active or semi-passive treatment systems may be technically and economically more attractive under these conditions. Active treatment approaches may also be better suited for heterogeneous geologies or sites where pH adjustment is required, as groundwater recirculation improves mixing and distribution of injected amendments within the subsurface. Longer treatment time frames, high contaminant concentrations, and secondary reactions may also present conditions favorable for utilizing an active approach, since amendment addition and mixing rates can be adjusted more easily than with passive approaches, which often utilize less frequent injection of amendments at high concentrations. However, these approaches may be limited where re-injection of contaminated water with amendments is either prohibited or subject to regulatory injection permits.

7.3 COST ANALYSIS

A cost analysis of PRT and three traditional cVOC groundwater treatment approaches was performed. Cost estimates for full scale applications were developed for the following technologies:

1. Proton reduction barrier;
2. Passive trench ZVI PRB;
3. Active pump and treat; and
4. Air Sparge/SVE.

The above technologies were selected for comparison because they are applicable for low pH aquifers. Bioremediation can also be effective in low pH aquifers when pH controls are added, but this technology was not included in the cost evaluation in order to provide a comparison of stand-alone technologies for low pH situations. The cost analyses comparing the above approaches are presented below based on a 30-year operating scenario.

7.3.1 Base Case Template

The base case presented in Krug et al., (2009) is used as a template for the cost analysis of the above technologies/approaches. The base case presents a situation where a shallow aquifer, consisting of homogeneous silty sands, is contaminated with TCE. The contaminated groundwater extends from 10 to 50 feet bgs, along the direction of groundwater flow for 800 feet, and is 400 feet in width (**Figure 7.1**). The specific base case site characteristics, including aquifer characteristics and design parameters for each of the remedial approaches analyzed are summarized in **Table 7.2**. The costing for the template site assumes that the source zone has been treated and that there is no continuing source of groundwater contamination.

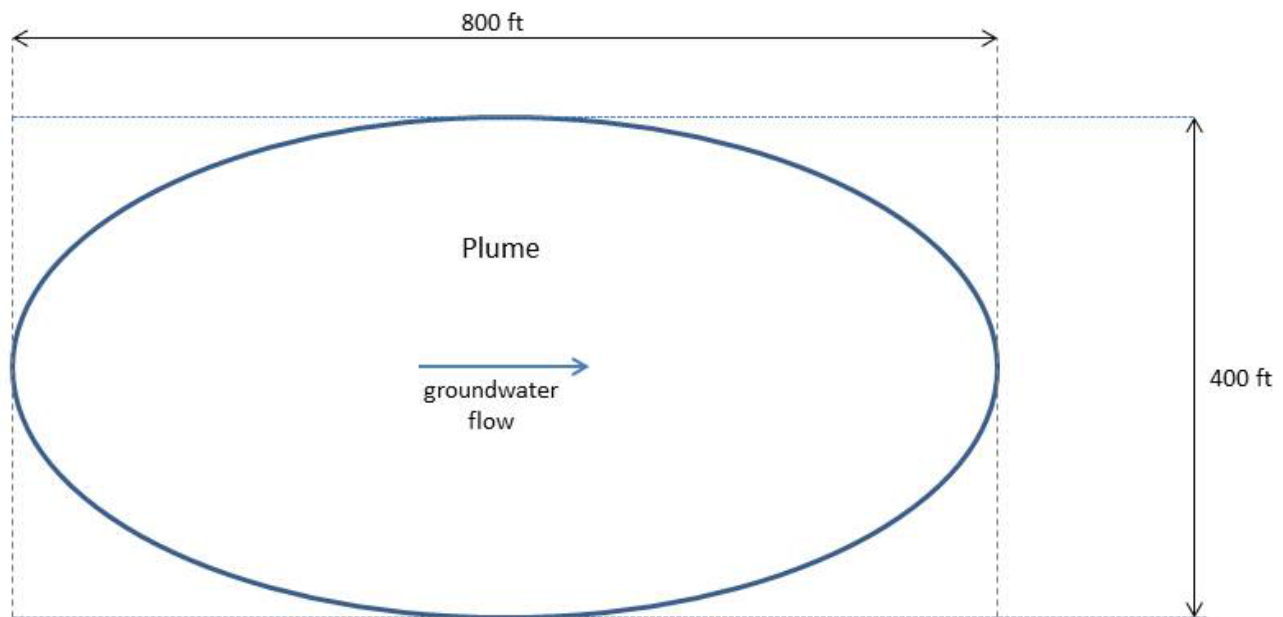


Figure 7.1. Base Case Plume Characteristics.

The following subsections provide cost estimates for implementation of each of the four treatment approaches for the base case. The cost estimates provide insight into the comparative capital, O&M, and long term monitoring costs to better identify cost drivers for each technology/approach. Total costs and the Net Present Value (NPV) of future costs were calculated for each of the treatment approaches. Future costs (O&M and long term monitoring costs) are discounted using a 1.5% real discount rate to determine the NPV estimates of these costs (OMB Circular A-94, 2016). Specifically excluded from consideration are the costs of pre-remedial investigations and treatability studies, assuming the costs for these activities would be similar for each alternative. The cost estimates for each of the alternatives also assumes the long-term performance monitoring costs are identical for each alternative. Monitoring is assumed to be at a quarterly frequency for the first 5 years and an annual frequency thereafter.

Table 7.2. Summary of Base Case Site Characteristics and Design Parameters

Design Parameter	Units	Alternative			
		Proton Reduction Barrier	ZVI PRB	Pump and Treat	Sparge / SVE
Width of Plume	feet	400	400	400	400
Length of Plume	feet	800	800	800	800
Depth to Water	feet	10	10	10	10
Vertical Saturated Thickness	feet	40	40	40	40
Porosity	dimensionless	0.25	0.25	0.25	0.25
Gradient	dimensionless	0.008	0.008	0.008	0.008
Hydraulic Conductivity	ft/day	2.8	2.8	2.8	2.8
Groundwater Seepage Velocity	ft/year	33	33	33	33
Nitrate Concentration	mg/L	15	15	15	15
Dissolved Oxygen Concentration	mg/L	5	5	5	5
Number of Barriers	each	1	1	1	1
Number of Monitoring Wells	each	10	10	10	10
Number of Sparge Wells	each	0	0	0	28
Number of SVE Wells	each	0	0	0	14
Number of Extraction/Injection Wells	each	0	0	9	0

7.3.2 Proton Reduction Barrier

The PRT barrier alternative assumes that a series of electrodes will be installed at the downgradient edge and perpendicular to the axis of the plume (**Figure 7.2**). The system will include 200 cathodes installed with a 2-foot spacing across the 400-foot wide plume. A system of 40 anodes will be installed downgradient of the cathodes. The electrodes will be installed by direct-push drilling methods, and consist of metal mesh electrode ribbon and coke breeze to provide electrical contact with the formation. A one-inch diameter PVC well will be installed with every fifth cathode.

Several electrical supply options for powering the PRT barrier were evaluated including the following:

1. off-grid solar with daytime only operation;
2. off-grid solar with 24 hour per day operation;
3. solar tied to grid; and
4. non-solar grid only.

Each of these options is described below and a cost comparison for the electrical supply components is provided in **Table 7.3**. The cost estimates assume other cost elements remain the same for system design, well and electrode installation, system installation, operations and maintenance, and long term monitoring.

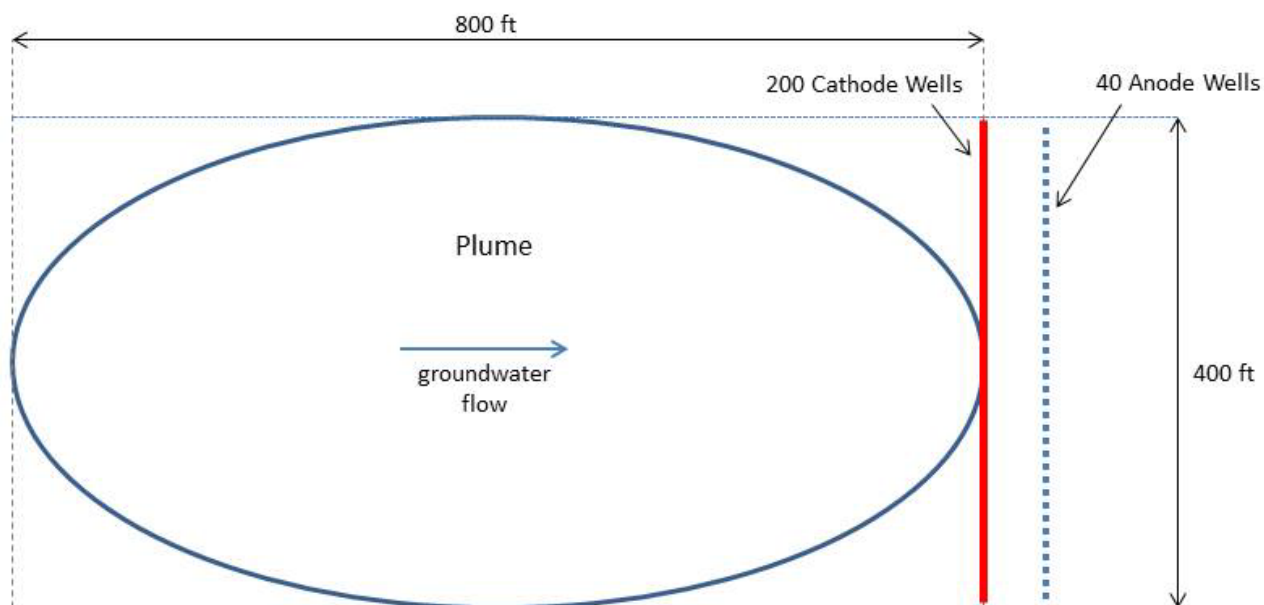


Figure 7.2. Proton Reduction Barrier Alternative for Plume Cutoff

Table 7.3. Cost Comparison of PRT System Electric Supply Options

Alternative	Capital Costs	NPV of 30 Years of O&M Costs	Total 30-Year Electrical Costs
Off-Grid Solar, Daytime-Only Operation	\$31	\$0	\$31
Off-Grid Solar, 24-Hour Operation	\$180	\$260	\$440
Solar Tied to Grid, 24-Hour Operation	\$150	\$0	\$150
Non-Solar Grid-Only, 24-Hour Operation	\$30	\$205	\$235

Notes:

All costs are in thousands of dollars

NPV - Net Present Value; current value of future costs based on a 1.4% annual discount rate

O&M - Operation and Maintenance

7.3.2.1 Off-Grid Solar, Daytime-Only Operation

This option includes a solar power array consisting of 40 200-watt solar panels to produce approximately 8 kilowatts of power. The system would operate only during daylight hours, thereby avoiding the need for battery storage of electricity. Cabling to each of the electrodes would be installed in conduit within utility trenches, and a control panel would regulate the power provided to each electrode.

This system is assumed to operate for 30 years with no other costs for electricity supply, and no additional O&M costs are associated with this option. This power-supply option has the lowest total cost of \$31k. The major limitation associated with this option is that the operating time is limited to daytime hours when there is sufficient sunlight. This could greatly reduce the ability of the PRT system to adjust aquifer pH, and to produce sufficient H₂.

7.3.2.2 Off-Grid Solar, 24-Hour Operation

This option includes battery storage and additional solar panels to provide the required power to operate the PRT system 24 hours per day with a totally off-grid solar power system. The capital costs for this option assume installation of 160 200-watt solar panels and 106 storage batteries to provide the 24-hour power requirements. Because of the batteries, this option has the highest capital costs at \$180K. The O&M costs assume the batteries are replaced every 5 years. Because of this, the 30-year NPV O&M costs are the highest of the options at \$260K. While this power-supply option is completely off-the-grid, it has the highest total 30-year cost at \$440K.

7.3.2.3 Solar Tied-to-Grid, 24-Hour Operation

This option assumes the solar power system is tied to the grid and excess solar power generated during peak hours is fed back to the grid to offset costs. The system is powered by solar panels during daylight hours and powered by the electrical grid during non-daylight hours. The system is designed to provide the necessary power by solar panels with no net cost for use of the grid. In this case the grid provides electrical storage similar to a battery. This option assumes installation of 160 200-watt solar panels. The primary capital cost includes the solar panels and installation of an electrical supply from a nearby source on the power grid. The cost for the grid power supply will be site-specific based on the distance to existing power lines. A cost of \$30,000 was used for cost estimating purposes. This option has no O&M costs because the solar panels offset the electrical consumption cost from the grid. This option has the second lowest total cost at \$150k, and provides the benefit of 24-hour system operations which is likely preferable for system optimization.

7.3.2.4 Non-Solar Grid-Only, 24-Hour Operation

This alternative assumes electrical power is derived entirely from the existing power grid and solar energy technology is not used. The primary capital cost includes installation of an electrical supply from a nearby power supply and installation of an AC/DC converter. The cost for the grid power supply will be site-specific based on the distance to existing power lines. A cost of \$30,000 was used for cost estimating purposes. Ongoing O&M costs include electricity consumption. A cost of \$8,410 per year is estimated to provide the 8 kW PRT system requirement 24-hours per day and 365 days per year, at a rate of \$0.12 per kW-hour. This alternative has the second highest total 30-year NPV cost of \$235K.

The electrical supply option chosen for our cost estimate to provide a comparison to the other remedial technologies was solar tied-to-grid with 24-hour operation. As summarized in **Table 7.4**, the estimated total costs for this alternative over 30 years are \$2,907K with a total NPV of lifetime costs of \$2,523K. The capital cost including design, work plan, installation of electrodes and monitoring wells in addition to the electrical supply costs described above are approximately \$642K. The NPV of the O&M is estimated at approximately \$1,061K for the 30 years of treatment. The O&M costs primarily include the labor and material costs associated with weekly inspections.

The costs for material and other consumables are negligible with this alternative. The NPV of the 30 years of monitoring and reporting costs is estimated to be \$820K.

Table 7.4. Cost components for PRT System

	Year Cost is Incurred							NPV of Costs*	Total Costs
	1	2	3	4	5	6	6 to 30		
CAPITAL COSTS									
System Design	70,000	-	-	-	-	-	-	70,000	70,000
Well Installation	214,735	-	-	-	-	-	-	214,735	214,735
System Installation	338,807	-	-	-	-	-	-	338,807	338,807
Start-up and Testing	17,978	-	-	-	-	-	-	17,978	17,978
SUBCOST (\$)	641,520	-	-	-	-	-	-	641,520	641,520
OPERATION AND MAINTENANCE COSTS									
System Operation and Maintenance	32,227	32,227	32,227	32,227	32,227	32,227	32,227 every year	1,061,326	1,305,824
SUBCOST (\$)	32,227	32,227	32,227	32,227	32,227	32,227		1,061,326	1,305,824
LONG TERM MONITORING COSTS									
Sampling/Analysis/Reporting (Quarterly through 5 years then Annually)	74,500	74,500	74,500	74,500	74,500	23,500	23,500 every year	820,411	960,000
SUBCOST (\$)	74,500	74,500	74,500	74,500	74,500	23,500		820,411	960,000
TOTAL COST (\$)	748,248	107,727	107,727	107,727	107,727	56,727		2,523,258	2,907,344

Notes:

NPV - Net Present Value

* - NPV calculated based on a 1.5% discount rate

This alternative ranks lowest in estimated total remedy cost and lowest in NPV of lifetime costs (see **Table 7.8**). The estimated capital cost for this approach is the second lowest of the four alternatives because of the limited infrastructure required. The estimated long-term O&M costs are the lowest of the four alternatives, which helps make this the least expensive of the alternatives. As with the other alternatives, total remedy costs will increase if the treatment needs to extend beyond 30 years.

7.3.3 Passive Trench ZVI PRB

The passive trench ZVI PRB alternative assumes an initial installation of a ZVI PRB in a trench at the downgradient edge and perpendicular to the axis of the plume (**Figure 7.3**). The PRB will consist of 25% ZVI filings and 75% coarse sand fill mixture (v/v). The PRB will be installed using the one-pass trenching/installation method, and will be 400 feet long, 2 feet wide, and extend down to 50 feet bgs. Pricing for this alternative assumes the PRB will need to be replaced every 10 years due to decline in ZVI reactivity and/or plugging. The PRB will be maintained for a period of 30 years, with replacements occurring in years 10 and 20. This alternative also assumes 30 years of associated O&M and long term monitoring costs.

As summarized in **Table 7.5**, the estimated total costs for this alternative over 30 years are \$3,648K with a total NPV of lifetime costs of \$3,205K. The capital cost including design, work plan, ZVI PRB installation, and installation of monitoring wells are approximately \$1,001K. The NPV of the O&M is estimated at approximately \$1,383K, which is the NPV associated with the replacement of the PRB every 10 years. The NPV of the 30 years of monitoring and reporting costs is estimated to be \$820K.

This alternative ranks second in estimated total remedy cost and NPV of lifetime costs (**Table 7.8**). The estimated capital costs for this approach are the second highest, due largely to the relatively high cost of the initial PRB installation. The long term O&M costs associated with this alternative are the second lowest due to the lack of O&M requirements between PRB replacements. The total remedy costs for this alternative would increase significantly if the PRB lifespan was less than 10 years or if treatment extended beyond 30 years.

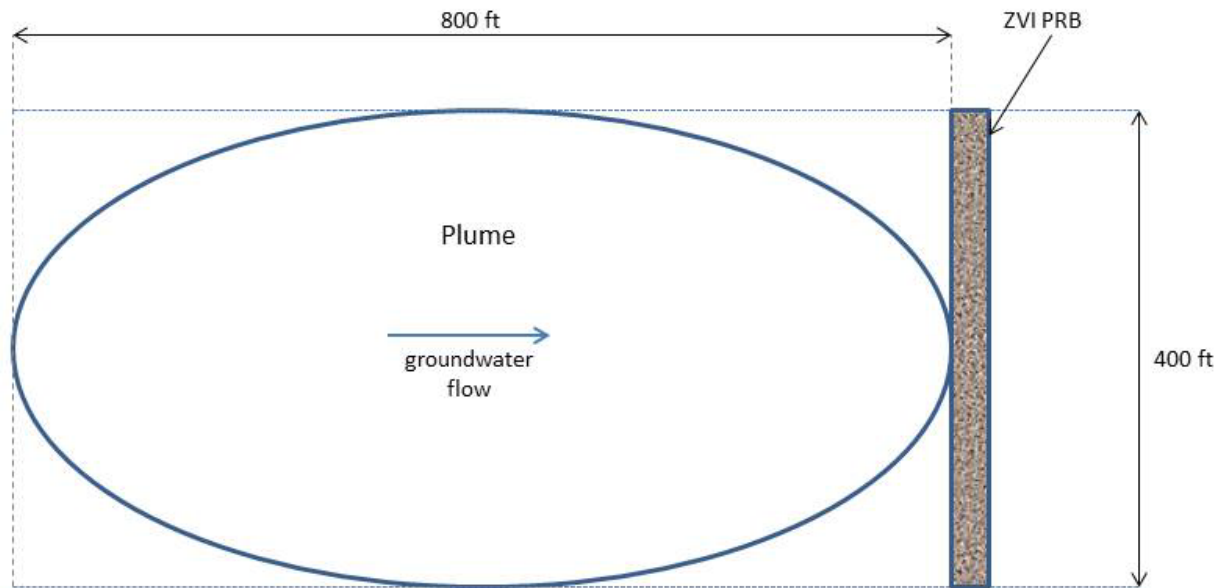


Figure 7.3. Passive Permeable Reactive Barrier Alternative Utilizing ZVI for Plume Cutoff

Table 7.5. Cost Components for ZVI PRB

	Year Cost is Incurred								NPV of Costs*	Total Costs
	1	2 to 5	6	7	8	9	10	11 to 30		
CAPITAL COSTS										
System Design	70,000		-	-	-	-	-		70,000	70,000
Well Installation	54,495		-	-	-	-	-		54,495	54,495
Trench Installation	876,554		-	-	-	-	-		876,554	876,554
Start-up and Testing**	-		-	-	-	-	-		0	0
SUBCOST (\$)	1,001,049		-	-	-	-	-		1,001,049	1,001,049
OPERATION AND MAINTENANCE COSTS										
ZVI Replacement Cost	-		-	-	-	-	843,647	843,647 year 20	1,383,162	1,687,294
SUBCOST (\$)	-		-	-	-	-	843,647		1,383,162	1,687,294
LONG TERM MONITORING COSTS										
Sampling/Analysis/Reporting (Quarterly through 5 years then Annually)	74,500	74,500 years 2 to 5	23,500	23,500	23,500	23,500	23,500	23,500 every year	820,411	960,000
SUBCOST (\$)	74,500		23,500	23,500	23,500	23,500	23,500		820,411	960,000
TOTAL COST (\$)	1,075,549		23,500	23,500	23,500	23,500	867,147		3,204,622	3,648,342

Notes:

NPV - Net Present Value

* - NPV calculated based on a 1.5% discount rate

** - No "Start-up and Testing" costs are included because no operating equipment is left behind following PRB installation

7.3.4 Active Pump and Treat

The groundwater extraction and treatment (pump and treat) system alternative is similar to the other technologies in that a downgradient barrier is installed (**Figure 7.4**). The system includes a row of four extraction and five injection wells, which would be used to create a groundwater capture zone at the downgradient edge perpendicular to the axis of the plume (**Figure 7.1**). The extracted groundwater would be treated above ground by air stripping followed by treatment with granular activated carbon (GAC). The treated groundwater would be re-injected providing hydraulic control and mass removal at the downgradient edge of the plume. The pump and treat system would be maintained for a period of 30 years. This alternative also assumes 30 years of associated O&M and long term monitoring costs.

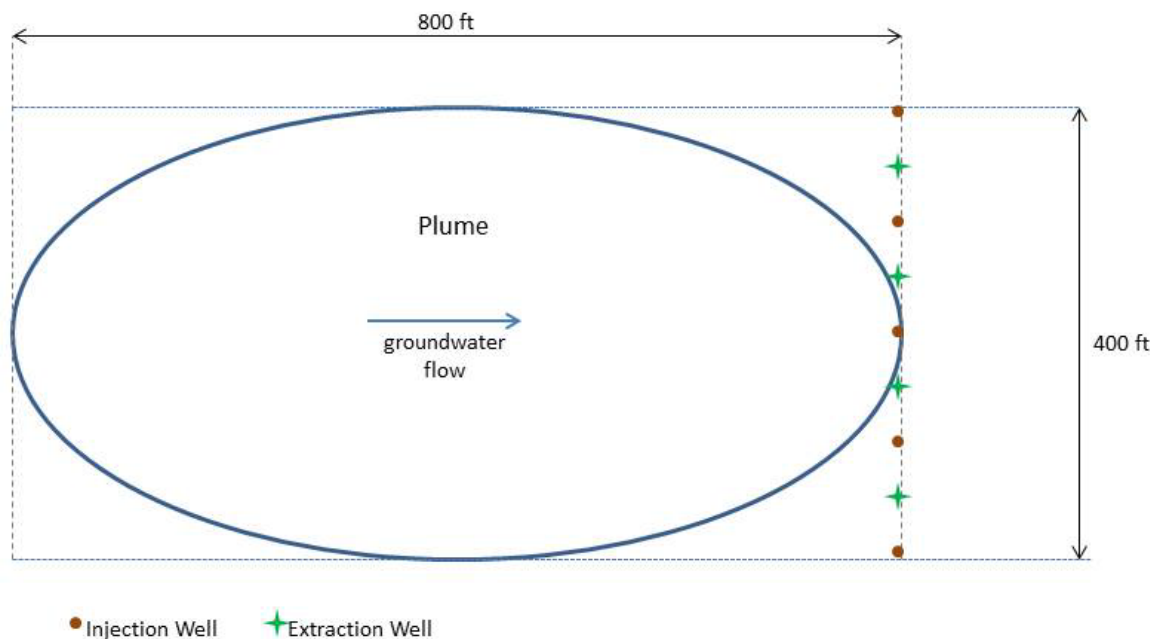


Figure 7.4. Pump and Treat Alternative for Plume Cutoff

As summarized in **Table 7.6**, the estimated total costs for this alternative over 30 years are \$7,049K with a total NPV of lifetime costs of \$6,093K. The capital cost including design, work plan, installation of extraction/injection and monitoring wells, construction of the groundwater treatment system, and system start up and testing are approximately \$1,737K. The NPV of the O&M is estimated at approximately \$3,535K. The O&M costs include the labor costs associated with system O&M, costs for equipment repair and replacement, electrical costs, and cost for the replacement and disposal of the GAC. The NPV of the 30 years of monitoring and reporting costs is estimated to be \$820K.

This alternative ranks highest in both estimated total remedy cost and NPV of lifetime costs (**Table 7.8**). The estimated capital costs for this alternative are higher than the other three alternatives because of the higher costs associated with constructing a groundwater treatment system. The high O&M costs associated with operating the pump and treat system are what makes this alternative one of the least attractive of the alternatives. As with the other approaches, total remedy costs will increase if the treatment needs to extend beyond 30 years.

Table 7.6. Cost Components for Pump and Treat

	Year Cost is Incurred							NPV of Costs*	Total Costs
	1	2	3	4	5	6	6 to 30		
CAPITAL COSTS									
System Design	90,352	-	-	-	-	-		90,352	90,352
Well Installation	128,350	-	-	-	-	-		128,350	128,350
System Installation	1,492,333	-	-	-	-	-		1,492,333	1,492,333
Start-up and Testing	26,250	-	-	-	-	-		26,250	26,250
SUBCOST (\$)	1,737,284	-	-	-	-	-		1,737,284	1,737,284
OPERATION AND MAINTENANCE COSTS									
System Operation and Maintenance	139,744	145,244	145,244	145,244	145,244	145,244	145,244 every year	3,534,990	4,351,834
SUBCOST (\$)	139,744	145,244	145,244	145,244	145,244	145,244		3,534,990	4,351,834
LONG TERM MONITORING COSTS									
Sampling/Analysis/Reporting (Quarterly through 5 years then Annually)	74,500	74,500	74,500	74,500	74,500	23,500	23,500 every year	820,411	960,000
SUBCOST (\$)	74,500	74,500	74,500	74,500	74,500	23,500		820,411	960,000
TOTAL COST (\$)	1,951,529	219,744	219,744	219,744	219,744	168,744		6,092,685	7,049,118

Notes:

NPV - Net Present Value

* - NPV calculated based on a 1.5% discount rate

7.3.5 Air Sparge/Soil Vapor Extraction

The Air Sparge/SVE alternative assumes that a series of sparge wells will be installed at the downgradient edge perpendicular to the axis of the plume shown in **Figure 7.5**. Spacing for the sparge wells is assumed to be 15 feet with both shallow and deep sparge wells installed at each of 27 locations for a total of 54 sparge wells. A sparge system will be constructed including a compressor, controls, and associated piping. A SVE system will be constructed to remove volatile organic compounds from the unsaturated zone. The system will include SVE wells at a spacing of 30 feet for a total of 14 SVE wells. The SVE system will also include a blower to remove the vapors and vapor-phase granular GAC. An enclosure will be installed to contain the above ground components. The sparge barrier will be operated for a period of 30 years, and this alternative assumes 30 years of associated O&M and long term monitoring costs.

As summarized in **Table 7.7**, the estimated total costs for this alternative over 30 years are \$4,717K with a total NPV of lifetime costs of \$3,999K. The capital cost is approximately \$673K including design, work plan, installation of sparge wells and construction of the SVE system along with startup and testing. The NPV of the O&M is estimated at approximately \$2,505K for the 30 years of treatment. The O&M costs include the labor costs associated with system O&M, costs for equipment repair and replacement, and cost for GAC replacement and disposal. The NPV of the 30 years of monitoring and reporting costs is estimated to be \$820K.

This alternative ranks second highest in estimated total remedy cost and NPV of lifetime costs, compared to the other alternatives (see **Table 7.8**). While the capital costs of this alternative are the second lowest, the high O&M costs, including electrical consumption and change-out of GAC, make this a less attractive remedial alternative.

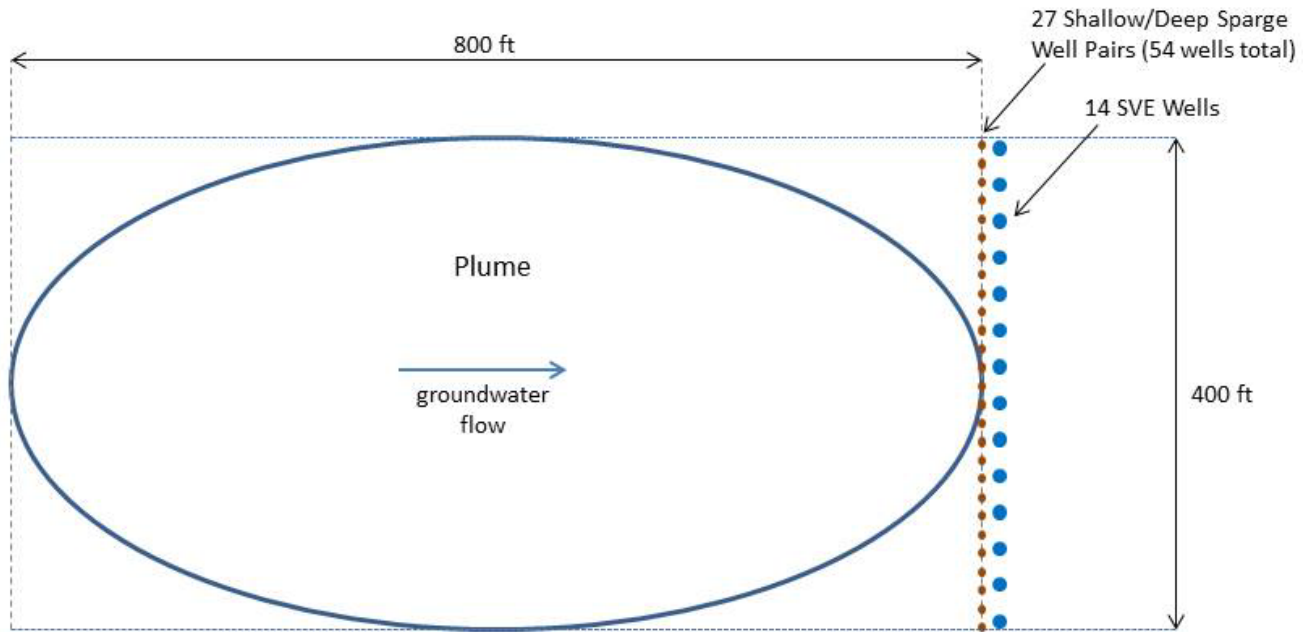


Figure 7.5. Air Sparge/Soil Vapor Extraction Alternative for Plume Cutoff

Table 7.7. Cost Components for Air Sparge/Soil Vapor Extraction.

	Year Cost is Incurred							NPV of Costs*	Total Costs
	1	2	3	4	5	6	6 to 30		
CAPITAL COSTS									
System Design	36,580	-	-	-	-	-	-	36,580	36,580
Well Installation	330,060	-	-	-	-	-	-	330,060	330,060
System Installation	238,774	-	-	-	-	-	-	238,774	238,774
Start-up and Testing	17,978	-	-	-	-	-	-	17,978	17,978
SUBCOST (\$)	623,392	-	-	-	-	-	-	623,392	623,392
OPERATION AND MAINTENANCE COSTS									
System Operation and Maintenance	101,812	102,812	102,812	102,812	102,812	102,812	102,812 every year	2,505,164	3,083,374
SUBCOST (\$)	101,812	102,812	102,812	102,812	102,812	102,812		2,505,164	3,083,374
LONG TERM MONITORING COSTS									
Sampling/Analysis/Reporting (Quarterly through 5 years then Annually)	74,500	74,500	74,500	74,500	74,500	23,500	23,500 every year	820,411	960,000
SUBCOST (\$)	74,500	74,500	74,500	74,500	74,500	23,500		820,411	960,000
TOTAL COST (\$)	799,704	177,312	177,312	177,312	177,312	126,312		3,948,967	4,666,765

Notes:

NPV - Net Present Value

* - NPV calculated based on a 1.5% discount rate

Table 7.8. Summary of Costs for Treatment Alternatives.

Alternative	Capital Costs	NPV of 30 Years of O&M Costs	NPV of 30 Years of Monitoring Costs	NPV of 30 Years of Total Remedy Costs	Total 30-Year Remedy Costs
Proton Reduction Barrier	\$642	\$1,061	\$820	\$2,523	\$2,907
ZVI PRB	\$1,001	\$1,383	\$820	\$3,205	\$3,648
Pump and Treat	\$1,737	\$3,535	\$820	\$6,093	\$7,049
Air Sparge / SVE	\$673	\$2,505	\$820	\$3,999	\$4,717

notes:

All costs are in thousands of dollars

NPV - Net Present Value; current value of future costs based on a 1.4% annual discount rate

O&M - Operation and Maintenance

8.0 IMPLEMENTATION ISSUES

Results of the demonstration showed that proton reduction technology can elevate the pH of groundwater, but that the process is slow because it depends on effective distribution of the high pH groundwater that accumulated in the cathode well. During this demonstration, even the recirculation of groundwater through the cathode well resulted in slow pH increases. The primary source of pH buffering in the system was clearly the aquifer sediments. Thus, pH adjustments using proton reduction alone is likely to require extensive treatment times. An alternative approach for using the technology for pH adjustment might involve an initial injection of base or buffer to overcome the soil buffering capacity, followed by proton reduction technology to maintain the elevated pH. This approach requires further testing and demonstration.

In addition to pH adjustment, the study also evaluated H₂ production and distribution. Evaluation of groundwater in the cathode wells at the site demonstrated that high levels of H₂ can be generated in situ, but distribution of this H₂ in the aquifer remains a challenge. Results of the demonstration suggested that the aquifer contained many potential sinks for H₂, including the reduction of Fe, Mn and sulfate that may need to be overcome to achieve high levels of sustained reductive dechlorination. The fact that dechlorination can be performed even with very low levels of H₂ (2 nM) suggests that even if distribution is not great, there may be sufficient H₂ in situ to support significant TCE dechlorination under better geochemical conditions (i.e., higher pH).

Results of the demonstration also showed that reductive dechlorination can potentially be supported by proton reduction technology, but, under the conditions of the demonstration, TCE dechlorination was not complete. The lack of complete dechlorination, even after bioaugmentation, was likely due to the borderline pH and reducing conditions achieved in the aquifer. It is possible that dechlorination activity could have been improved if a higher pH (e.g., pH 6.5 to 7) and/or more reducing conditions (e.g., ORP < -100 mV) were consistently achieved.

Overall, the results of this demonstration show that achieving elevated pH levels in naturally acidic aquifers like those at JB MDL remains a significant challenge. Although proton reduction showed some potential for increasing pH and lowering ORP, the configuration of the PRT system during this demonstration was not sufficient for achieving and maintaining optimal geochemical conditions extended periods. Because a circum-neutral pH and highly-reducing conditions could not be achieved, efficient dechlorination of TCE also could not be achieved. Proton reduction technology, therefore, may be a useful component of a treatment system for remediating an acidic aquifer, with additional treatments/amendments needed to better address and overcome the significant soil buffering capacity of such aquifers. Or, PRT could be reconfigured to better address the shortcoming observed during this demonstration.

The results of the study, however, have provided some guidance for future development and application of this technology. Clearly, the distribution of H₂ in situ is challenged by both competitive H₂ consumption by non-dechlorinating bacteria, and also by the relatively low solubility of H₂. Likewise, the distribution of high pH groundwater from around the cathodes is limited, especially if groundwater flow is determined by natural flow gradients. One approach that has recently been shown to mitigate these limitations is using more closely-spaced electrodes. This approach has been successfully tested in the field under the U.S. Navy's Environmental Sustainability Development to Integration (NESDI) program, and is designated NESDI Project 501.

This demonstration was conducted within a low pH cVOC-contaminated aquifer at the southern end of the Russell Road Landfill, located at Marine Corps Base Quantico, in Quantico, Virginia. During this 1-year field demonstration, eight closely-spaced cathodes and two downgradient anodes were installed in a barrier configuration to provide greater aquifer pH adjustment and H₂ delivery to contaminated groundwater passing through the barrier. As detailed in the September 2016 Bi-Monthly Project Status Report (provided in **Appendix E**), decreases in cis-DCE (the primary contaminant of concern) ranging from 88 to 99 percent have been observed in the 5 treatment zone wells during this demonstration.

Furthermore, we have determined through lab and field testing at Quantico that the current through the aquifer can be increased, if better contact is achieved between the electrodes and the soils. This results in greater rates of hydrolysis, acid consumption and H₂ production. That is, placing electrodes within a PVC monitoring well with acidic, low conductivity, groundwater is equivalent to suspending the electrode in a resistor. Improved soil contact can be achieved by using metallurgical soil contact material like Coke Breeze (Loresco, Hattisburg, MS) as a backfill around the mixed metal oxide coated Elgard mesh electrodes used during this demonstration. These backfill materials are engineered to have low resistance and to improve contact between electrodes and soils. They are inexpensive and used primarily in corrosion prevention systems. The use of this material also should eliminate the need for the installation of a monitoring/electrode well with each electrode. This approach was used successfully during AFCEC Project 501, and has been shown to reduce electrode installation costs so that electrodes can be closely spaced. It is also believed that this electrode installation method (which includes a bentonite seal above the backfill) may reduce the loss of H₂ (as H₂ gas) that was observed through the top of the well casings during this project.

9.0 REFERENCES

- Adamson, D.T., D.Y. Lyon, and J.B. Hughes. 2004. Flux and product distribution during biological treatment of tetrachloroethene dense non-aqueous-phase liquid. *Environ. Sci. Technol.* 38:2021-2028.
- Adrian, N.R., C.M. Arnett, and R.F. Hickey. 2003. Stimulating the anaerobic biodegradation of explosives by the addition of hydrogen or electron donors that produce hydrogen. U.S. Army Corps of Engineers, Washington DC. ERDC/CERL MP-03-3.
- Amos, B.K., E.J. Suchomel, K.D. Pennell, and F.E. Löffler. 2008. Microbial activity and distribution during enhanced contaminant dissolution from a NAPL source zone. *Water Res.* 42:2963-2974.
- Aziz, C.E., S.K. Farhat, J.M. McDade, and C.J. Newell. 2003. Low-volume hydrogen biosparging in a controlled release system. Paper B-03 in V.S. Magar and M.E. Kelly (eds) *Proceedings of the seventh international in situ and on-site Bioremediation symposium*. Battelle Press. Columbus, OH.
- Ballapragada, B.S., H.D. Stensel, J.A. Puhakka, and J.F. Ferguson. 1997. Effect of hydrogen on reductive dechlorination of chlorinated ethenes. *Environ. Sci. Technol.* 31:1728-1734.
- Call, D., and B.E. Logan. 2008. Hydrogen production in a single chamber microbial electrolysis cell (MEC) lacking a membrane. *Environ. Sci. Technol.* 42:18871-18873.
- Carr, C.S., and J.B. Hughes. 1998. Enrichment of high-rate PCE dechlorination and comparative study of lactate, methanol, and hydrogen as electron donors to sustain activity. *Environ. Sci. Technol.* 32:1817-1824.
- Cheng, S., and B.E. Logan. 2007. Sustainable and efficient biohydrogen production via electrohydrogenesis. *Proc. Natl. Acad. Sci.* 104:18871-18873.
- Chu, M., P.K. Kitanidis, and P.L. McCarty. 2004. Possible factors controlling the effectiveness of bioenhanced dissolution of non-aqueous phase tetrachloroethene. *Adv. Water Resour.* 27:601-615.
- Chung, J., R. Krajmalnik-Brown, and B.E. Rittmann. 2008. Bioreduction of trichloroethene using a hydrogen-based membrane biofilm reactor. *Environ. Sci. Technol.* 42:477-483.
- Clapp, L.W., M.J. Semmens, P.J. Novak, and R.M. Hozalski. 2004. Model for in situ perchloroethene dechlorination via membrane-delivered hydrogen. *J. Environ. Eng.* 130:1367-1381.
- Conrad, R. and B. Wetter. 1990. Influence of temperature on energetics of hydrogen metabolism in homoacetogenic, methanogenic, and other anaerobic bacteria. *Arch. Microbiol.* 155:94-98.

- Eaton, A.D., Clesceri, E.W. Rice, and A. E. Greenberg (eds). 2005. *Standard Methods for the Examination of Water and Wastewater*, 21st Edition. Port City Press, Baltimore, MD.
- Fetter, C.W. 1994. *Applied Hydrogeology*, 3rd Edition. Prentice Hall, Upper Saddle River, NJ.
- Fisher, R.T., J.B. Hughes, and C.J. Newell. 1997. Process for in-situ biodegradation of chlorinated aliphatic hydrocarbons by subsurface hydrogen injection. US Patent 5,602,296.
- FRTR (Federal Remediation Technologies Roundtable). 1998. *Guide to Documenting and Managing Cost and Performance Information for Remediation Projects*, Revised version. EPA 542-B-98-007. October.
- Gent, D.B., A.H. Wani, J.L. Davis, and A. Alshawabkeh. 2009. Electrolytic redox and electrochemical generated alkaline hydrolysis of hexahydro-1,3,5-trinitro-1,3,5 triazine (RDX) in sand columns. *Environ. Sci. Technol.* 43:6301-6307.
- Gilbert, D., T. Sale, and M. Peterson. 2008. Final Report Addendum, Electrically Induced Redox Barriers for Treatment of Groundwater, ESTCP Project ER-0112. December. Online: <https://www.serdp-estcp.org/content/search?qcp=Standard&SearchText=cu-0112&x=0&y=0>.
- Harkness, M. R., A.A. Bracco, M.J. Brennan, Jr., K.A. DeWeerd, and J.L. Spivack. 1999. Use of bioaugmentation to stimulate complete reductive dechlorination of trichloroethene in Dover soil columns. *Environ. Sci. Technol.* 33:1100-1109.
- Hatzinger., P.B. 2005. Perchlorate biodegradation for water treatment. *Environ. Sci. Technol.* 39:239A-247A.
- Hatzinger, P.B., J. Diebold, C.A. Yates, and R.J. Cramer. 2006. Chapter 14: Field demonstration of in situ perchlorate bioremediation in groundwater. In *Perchlorate: Environment Occurrence, Interactions, and Treatment*, B. Gu and J. C. Coates (ed.). Springer, New York. pp. 311-341.
- He, J., Y. Sung, M.E. Dollhopf, B.Z. Fathepure, J.M. Tiedje, and F.E. Löffler. 2002. Acetate versus hydrogen as direct electron donors to stimulate the microbial reductive dechlorination process at chloroethene-contaminated sites. *Environ. Sci. Technol.* 36:3945-3952.
- Holliger, C., G. Wahlfarth, and G. Diekert. 1999. Reductive dechlorination in the energy metabolism of anaerobic bacteria. *FEMS Microbiol. Rev.* 22:383-398.
- Jin S., and P. Fallgren. P. 2010. Electrically induced reduction of trichloroethene in clay. *J. Hazard Mater.* 173: 200-204.
- Krug, T.A., C. Wolfe, R.D. Norris, and C.J. Winstead. 2009. Cost Analysis of In Situ Perchlorate Bioremediation Technologies. In *In Situ Remediation of Perchlorate in Groundwater*. H.F. Stroo and C.H. Ward, Eds. SERDP/ESTCP Environmental Remediation Technology.

- Lacroix, E., A. Brovelli, D.A. Barry, and C. Holliger. 2014. Use of silicate minerals for pH control during reductive dechlorination of chloroethenes in batch cultures of different microbial consortia. *Appl. Environ. Microbiol.* 80:3858-3867.
- Lee, M.D., J.M. Odom, and R.J. Buchman. 1998. New perspectives on microbial dehalogenation of chlorinated solvents : insights from the field. *Ann. Rev. Microbiol.* 52 :423-452.
- Lendvay, J.M., F.E. Löffler, M. Dollhopf, M.R. Aiello, G. Daniels, B.Z. Fathepure, M. Gebhard, R. Heine, R. Helton, J. Shi, R. Krajmalnik-Brown, C.L. Major, Jr., M.J. Barcelona, E. Petrovskis, R. Hickey, J.M. Tiedje, and P. Adriaens. 2003. Bioreactive barriers: A comparison of bioaugmentation and biostimulation for chlorinated solvent remediation. *Environ. Sci. Technol.* 37:1422-1431.
- Lohner, S.T. and A. Tiehm. 2009. Application of electrolysis to stimulate microbial reductive dechlorination and oxidative VC biodegradation. *Environ. Sci. Technol.* 43:7098-7104.
- Lohner, S.T., D. Becker, K.-M. Mangold, and A. Tiehm. 2011. Sequential reductive and oxidative biodegradation of chloroethenes stimulated in a coupled bioelectro-process. *Environ. Sci. Technol.* 45:6191-6197.
- Löffler, F.E., J.M. Tiedje, and R.A. Sanford. 1999. Fraction of electrons consumed in electron acceptor reduction and hydrogen thresholds as indicators of halo-respiratory physiology. *Appl. Environ. Microbiol.* 65:4049-4056.
- Löffler, F.E., J. Yan, K.M. Ritalahti, L. Adrian, E.A. Edwards, K.T. Konstantinidis, J.A. Müller, H. Fullerton, S.H. Zinder and A.M. Spormann. 2013. *Dehalococcoides mccartyi* gen. nov., sp. nov., obligate organohalide-respiring anaerobic bacteria relevant to halogen cycling and bioremediation, belong to a novel bacterial class, *Dehalococcoidia* classis nov., within the phylum Chloroflexi. *Int. J. Syst. Evol. Microbiol.* 63:625-635.
- Lowe, S.E., M.K. Jain, and J.G. Zeikus. 1993. Biology, ecology, and biotechnological applications of anaerobic bacteria adapted to environmental stresses in temperature, pH, salinity or substrates. *Microbiol. Rev.* 57:451-509.
- Ma, X., P.J. Novak, L.W. Clapp, M.J. Semmens, and R.M. Hozalski. 2003. Evaluation of polyethylene hollow-fiber membranes for hydrogen delivery to support reductive dechlorination in a soil column. *Water. Res.* 37:2905-2918.
- Ma, X., P.J. Novak, M.J. Semmens, L.W. Clapp, and R.M. Hozalski. 2006. Comparison of pulsed and continuous addition of H₂ gas via membranes for stimulating PCE biodegradation in soil columns. *Water Res.* 40:1155-1166.
- Major, D.W., M.L. McMaster, E.E. Cox, E.A. Edwards, S.M. Dworatzek, E.R. Hendrickson, M.G. Starr, J.A. Payne, and L.W. Buonamici. 2002. Field demonstration of successful bioaugmentation to achieve dechlorination of tetrachloroethene to ethene. *Environ. Sci. Technol.* 36:5106-5116.

- Maymó-Gatell, X., V. Tandoi, J.M. Gossett, and S.H. Zinder. 1995. Characterization of an H₂-utilizing enrichment culture that reductively dechlorinates tetrachloroethene to vinyl chloride and ethene in the absence of methanogenesis and acetogenesis. *Appl. Environ. Microbiol.* 61:3928-3933.
- Maymó-Gatell, X., Y.-T Chien, J.M. Gossett, and S.H. Zinder. 1997. Isolation of a bacterium that reductively dechlorinates tetrachloroethene to ethene. *Science* 276:1568-1571.
- McCarty, P.L., M.Y. Chu, and P.K. Kitanidis. 2007. Electron donor and pH relationships for biologically enhanced dissolution of chlorinated solvent DNAPL in groundwater. *Eur. J. Soil Biol.* 43:276-282.
- Nerenberg, R., Y. Kawagoshi, and B.E. Rittman. 2006. Kinetics of a hydrogen-oxidizing, perchlorate-reducing bacterium. *Water Res.* 40:3290-3296.
- New Jersey Department of Environmental Protection. 2003. Low-flow Purging and Sampling Guidance.
- Olson, E.R. 1983. Influence of pH on bacterial gene expression. *Mol. Microbiol.* 8:5-15.
- Page, A.L., R.H. Miller, and D.R. Keeney (eds). 1982. *Method of Soil Analyses. Part 2: Chemical and Microbiological Properties.* Second Edition. American Society of Agronomy, Inc. Madison WI. ISBN 0-89118-072-9.
- Rahner D., G. Ludwig, and J. Röhrs, J. 2002. Electrochemically induced reactions in soils—a new approach to the in-situ remediation of contaminated soils? Part 1: The microconductor principle. *Electrochim. Acta.* 47:1395-1403.
- Ritalahti, K.M., J.K. Hatt, V. Lugmayr, K. Henn, E.A. Petrovskis, D.M. Ogles, G.A. Davis, C.M. Yeager, C.A. Lebron, and F.E. Loeffler. 2010. Comparing on-site to off-site biomass collection for *Dehalococcoides* biomarker gene quantification to predict in situ chlorinated ethene detoxification potential. *Environ. Sci. Technol.* 44:5127–5133.
- Röhrs J., G. Ludwig, and D. Rahner. 2002. Electrochemically induced reactions in soils—a new approach to the in-situ remediation of contaminated soils? Part 2: remediation experiments with a natural soil containing highly chlorinated hydrocarbons. *Electrochim. Acta.* 47:1405-1414.
- Sale, T., M. Olson, D. Gilbert, and M. Petersen. 2010. Final Report: Field Demonstration/ Validation of Electrolytic barriers for Energetic Compounds at Pueblo Chemical Depot, ESTCP Project ER-0519. January.
- Schaefer, C.E., Lippincott, D.R., Steffan, R.J., 2010. Field-Scale Evaluation of Bioaugmentation Dosage for Treating Chlorinated Ethenes. *Groundwater Monit. Remed.* 30:113-124.
- Selembo, P.A., M.D. Merrill, and B.E. Logan. 2009. The use of stainless steel and nickel alloys as low-cost cathodes in microbial electrolysis cells. *J. Power Sources.* 190:271-278.

- Shaw Environmental, Inc. 2012. Draft Field Demonstration Plan for Solar Powered Remediation and pH Control. Project ER-201033. March.
- Steffan, R.J., K.L. Sperry, M.T. Walsh, S. Vainberg, and C.W. Condee. 1999. Field-scale evaluation of in situ bioaugmentation for remediation of chlorinated solvents in groundwater. *Environ. Sci. Technol.* 33:2771-2781.
- Steffan, R., C. Schaefer, and D. Lippincott. 2010. Final Report: Bioaugmentation for Groundwater Remediation, ESTCP Project ER-0515. Prepared for Environmental Security Technology Certification Program. February.
- Sung, Y., K.M. Ritalahti, R.A. Sanford, J.W. Urbance, S.J. Flynn, J.M. Tiedje, and F.E. Löffler. 2003. Characterization of two tetrachloroethene-reducing, acetate-oxidizing anaerobic bacteria and their description as *Desulfuromonas michiganensis* sp. nov. *Appl. Environ. Microbiol.* 69:2964-2974.
- Tetra Tech, Inc., 2008. Final Environmental Accelerated Investigation and Due Diligence Report, McGuire Air Force Base, New Jersey, May.
- USEPA. 2009. National Primary Drinking Water Regulations. EPA 816-F-09-004. May. Online: <https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulation-table>.
- Vainberg, S., C.W. Condee, and R.J. Steffan. 2009. Large scale production of *Dehalococcoides* sp.-containing cultures for bioaugmentation. *J. Indust. Microbiol. Biotechnol.* 36:1189-1197.
- Wang, Y.-T., and H. Shen. 1995. Bacterial reduction of hexavalent chromium. *J. Indust. Microbiol.* 14:159-163.
- Yang, Y., and P.L. McCarty. 1998. Competition for hydrogen within a chlorinated solvent dehalogenating anaerobic mixed culture. *Environ. Sci. Technol.* 32: 3591–3597.
- Zhang, XH, G.W. Sewell, and S.Y. Cui. 2001. An improved method of hydrogen production as electron donor for anaerobic bioremediation. *J. Environ. Sci. Health, Part A.* 36:1661-1670.
- Zhuang, P., and S.G. Pavlostathis. 1995. Effect of temperature, pH, and electron donor on the microbial reductive dechlorination of chloroalkenes. *Chemosphere.* 31:3537-3548.

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APPENDIX A POINTS OF CONTACT

Point of Contact Name	Organization Name Address	Phone Fax Email	Role in Project
David Lippincott	CB&I Federal Services 17 Princess Road Lawrenceville, NJ 08648	609-895-5380 direct 609-605-0883 cell david.lippincott@cbifederalservices.com	Principal Investigator
Robert Steffan	Formerly CB&I Federal Services (Retired) 17 Princess Road Lawrenceville, NJ 08648	267-337-2005 cell drjs@comcast.net	Former Principal Investigator (Retired)
Andrea Leeson	SERDP/ESTCP 901 N Stuart Street, Suite 303 Arlington VA 22203	703-696-2118 direct 703-696-2114 fax andrea.leeson@osd.mil	ESTCP Environmental Restoration Program Manager
Curtis Frye	Joint Base McGuire-Dix-Lakehurst Environmental Restoration Program 2403 Vandenberg Avenue Joint Base McGuire-Dix-Lakehurst, NJ 08641	609-754-4952 direct curtis.frye@us.af.mil	Environmental Restoration Chief – Joint Base McGuire-Dix-Lakehurst

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APPENDIX B PUMP AND RECOVERY TEST DATA

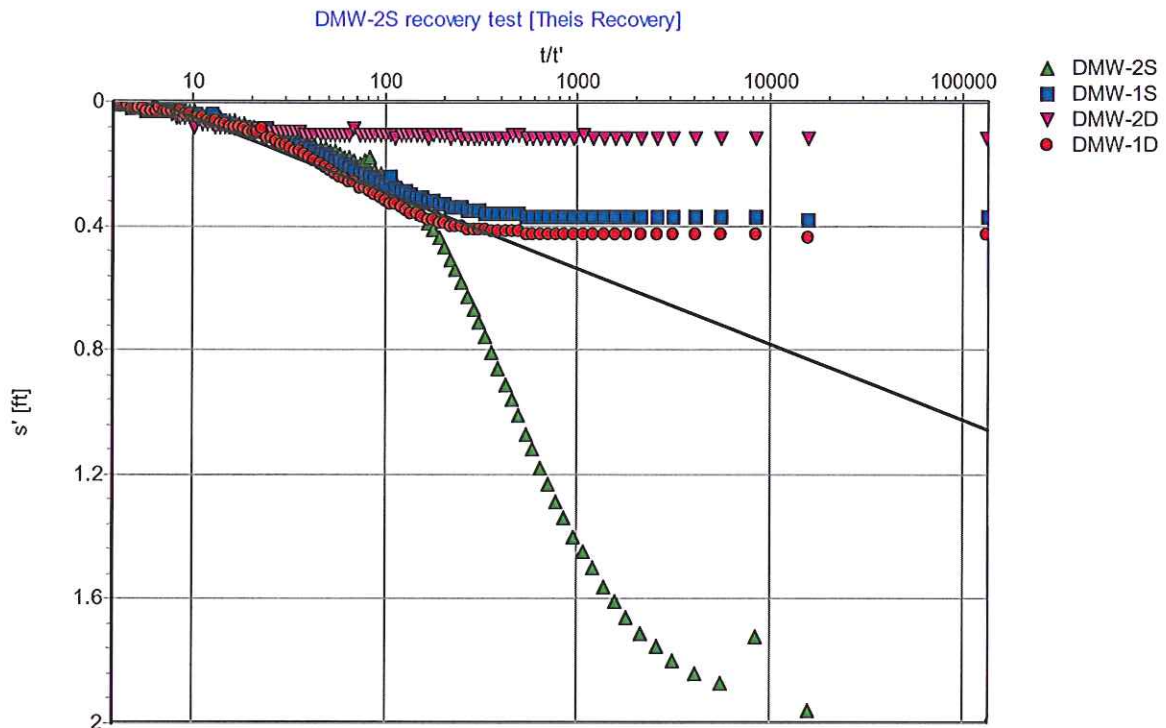


Shaw Environmental Inc.

185 Berry St.
San Francisco
Phone 415.512.2400

Pumping Test Analysis Report

Project: McGuire Air Force Base
Number: 138914
Client: US Air Force



Pumping Test: DMW-2S recovery test

Analysis Method: Theis Recovery

Analysis Results:

Transmissivity:	1.01E+2 [ft ² /d]	Mean Error (ME):	0.00E+0
		Sum of Squares Error (SSE):	0.00E+0
Conductivity:	5.25E+0 [ft/d]	Variance (VAR):	0.00E+0
		Standard Deviation (SDEV):	0.00E+0

Note: Analysis results are averaged from all active observation wells.

Analysis Details:

Well Name	T ft ² /d	S	K ft/d			ME ft	SSE ft	VAR ft	SDEV ft
DMW-1D	1.455E+02	5.473E-04	7.529E+00			-7.79E-04	1.85E-01	1.16E-03	3.40E-02
DMW-1S	1.677E+02	3.668E-04	8.680E+00			-1.86E-03	1.24E-01	7.73E-04	2.78E-02
DMW-2D	8.100E+01	1.535E+00	4.192E+00			-1.43E-02	1.32E-02	8.26E-05	9.09E-03
DMW-2S	9.312E+01	6.336E-06	4.820E+00			7.96E-04	1.72E+01	1.08E-01	3.28E-01

Test Details: Saturated Aquifer Thickness: 19.32 ft

Pumping Well:	X ft	Y ft	TOC Elev. ft	L ft	R ft	r ft	Q U.S. gal/min	Well Screen
DMW-2S	465988.85	436972.17	114.71		0.21	0.1	Variable	Fully Penetrating

**Shaw Environmental Inc.**

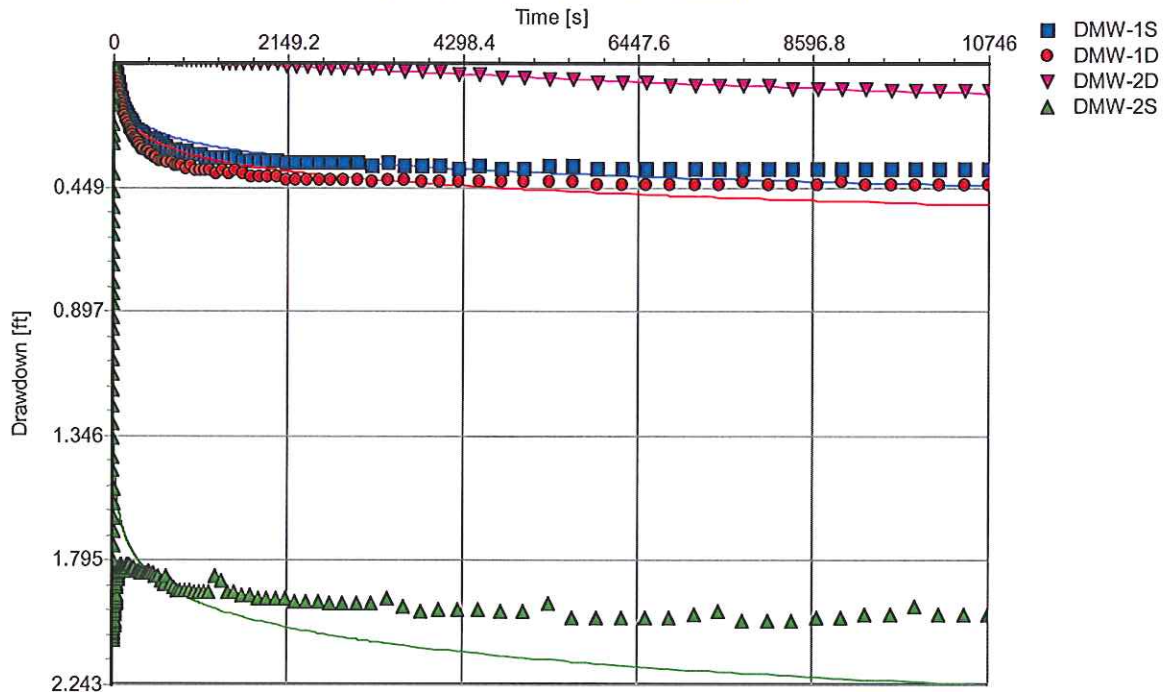
185 Berry St.
San Francisco
Phone 415.512.2400

Pumping Test Analysis Report

Project: McGuire Air Force Base

Number: 138914

Client: US Air Force

DMW-2S Pump Test [Theis (1935) - Forward Solution]

Pumping Test: DMW-2S Pump Test

Analysis Method: Theis (1935) - Forward Solution

Analysis Results:

Transmissivity:	1.22E+2 [ft ² /d]	Mean Error (ME):	-4.02E-3
Storativity:	3.84E-1	Sum of Squares Error (SSE):	4.39E+0
Conductivity:	6.31E+0 [ft/d]	Variance (VAR):	2.74E-2
		Standard Deviation (SDEV):	9.98E-2

Note: Analysis results are averaged from all active observation wells.

Analysis Details:

Well Name	T ft ² /d	S	K ft/d			ME ft	SSE ft	VAR ft	SDEV ft
DMW-1D	1.455E+02	5.473E-04	7.529E+00			-7.79E-04	1.85E-01	1.16E-03	3.40E-02
DMW-1S	1.677E+02	3.668E-04	8.680E+00			-1.86E-03	1.24E-01	7.73E-04	2.78E-02
DMW-2D	8.100E+01	1.535E+00	4.192E+00			-1.43E-02	1.32E-02	8.26E-05	9.09E-03
DMW-2S	9.312E+01	6.336E-06	4.820E+00			7.96E-04	1.72E+01	1.08E-01	3.28E-01

Test Details: Saturated Aquifer Thickness: 19.32 ft

Pumping Well:	X ft	Y ft	TOC Elev. ft	L ft	R ft	r ft	Q U.S. gal/min	Well Screen
DMW-2S	465988.85	436972.17	114.71		0.21	0.1	Variable	Fully Penetrating

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APPENDIX C PROPERTIES OF ELGARD 150



MIXED METAL OXIDE ELGARD 150 RIBBON MESH

REVISION 1

ELGARD™ Anode ribbon mesh is composed of a precious metal oxide catalyst sintered to an expanded Titanium mesh substrate. The Anode Ribbon Mesh is used as a key component in the Cathodic Protection of Reinforced Concrete Structures.

MATERIAL SPECIFICATIONS

ANODE PERFORMANCE	
Current rating @ 110 mA/m ² (10 mA/ft ²)	5.28 mA/m (1.61 mA/ft)
Expected life (NACE Standard TMO2944-94)	75 Years
Catalyst	Iridium Based Mixed Metal Oxide
Maximum anode concrete interface current density	
FHWA limit	110 mA/m ² (10 mA/ft ²)
Short-term limit	220 mA/m ² (20 mA/ft ²)
NOMINAL DIMENSIONS	
Width	19 mm (0.75 ")
Coil length	76m (250 ft)
Actual anode surface per unit length of anode	0.048 m ² /m (0.157 ft ² /ft)
Expanded thickness	1.30 mm (0.051 ")
Diamond dimensions	2.5 x 4.6 x 0.6 mm (0.10 " x 0.18 " x 0.025 ")
Shipping weight per coil	2.7 kg (6 lbs)
SUBSTRATE	
Composition	Titanium, Grade 1 per ASTM B265
Coefficient of thermal expansion	8.7 x 10 ⁻⁵ /°K (0.0000048/in/in/°K)
Thermal conductivity @ 20°C	15.6W/ m ² - °K (9.0BTU/hr/ft ² /°F/ft)
Electrical resistivity	0.000056 Ohm-cm (0.000022 Ohm-in)
Modulus of elasticity	105 GPa (14,900,000 PSI) minimum
Tensile strength	245 MPa (35,000 PSI) minimum
Yield strength	175 MPa (25,000 PSI) minimum
Elongation	24% minimum
CURRENT DISTRIBUTOR	
Width	12.70 mm (0.5 ")
Thickness	0.90 mm (0.035 ")
Coil length	76 m (250 ft)
Shipping weight per coil	3.9 kg (8.6 lbs)
ELECTRICAL PROPERTIES	
Anode ribbon mesh resistance lengthwise	0.26 Ohm/m (0.08 Ohm/ft)
Current distributor resistance lengthwise	0.049 Ohm/m (0.015 Ohm/ft)

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APPENDIX D ANALYTICAL DATA

DATABASE QUALIFIERS

BOLD indicates the compound was detected above the reporting limit.

Values highlighted in yellow indicate that the compound was detected above the PQL/GWQC.

U - The compound was not detected at the indicated concentration.

J - Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than zero. The concentration given is an approximate value.

B - The analyte was found in the laboratory blank as well as the sample. This indicates possible laboratory contamination of the sample.

NS - Not Sampled.

Values shaded in green indicate a shortened (15 minute) purge time.

ND - No Data. This indicates that a sample was collected but no data resulted from that sample.

NR- No Reading, equipment interference.

D - Sample was diluted prior to analysis.

E - Estimated value, beyond linear range.

Table D.1. BMW-1S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	BMW-1S	
Lab Sample No.	POLs and	8534-8	8539-12	8649-15	8665-18	8678-4		8852-12	8896-1	8905-1	8929-8	8954-2	9040-1	9051-7
Sampling Date	GW Quality	10/27/2011	11/10/2011	3/27/2012	4/18/2012	5/2/2012	5/9/2012	10/23/2012	1/17/2013	2/7/2013	3/14/2013	4/24/2013	11/12/2013	12/18/2013
Time (day)		-45	-32	106	128	142	149	316	402	423	458	499	701	737
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
chloromethane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
vinyl chloride	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	1.01 J
bromomethane	10	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
chloroethane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
trichlorofluoromethane	2000	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1-dichloroethylene	1	50.0 U	3.0 J	105 U	NS	NS	NS	42.0 U	1.7 J	25.0 U	25.0 U	25.0 U	4.78 J	4.06 J
methylene chloride	3	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	1.9 J	25.0 U	25.0 U	25.0 U	2.45 J	2.67 J
1,1-dichloroethane	50	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
2,2-dichloropropane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
cis 1,2-dichloroethylene	70	168 D	140 D	147 D	NS	NS	NS	209 D	145	126 D	138 D	143 D	188	291
bromochloromethane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
chloroform	70	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	30	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
carbon tetrachloride	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1-dichloropropane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
benzene	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2-dichloroethane	2	50.0 U	25.0 U	105 U	NS	NS	NS	4440 D	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
trichloroethylene	1	8970 D	9580 D	4980 D	NS	NS	NS	4440 D	3550 D	3260 D	3900 D	4170 D	9170 D	5060 ED
1,2-dichloropropane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
dibromomethane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
bromodichloromethane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
toluene	600	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
trans-1,3-dichloropropene	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	3	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
tetrachloroethylene	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,3-dichloropropane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
dibromochloromethane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2-dibromomethane		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
chlorobenzene	50	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
ethylbenzene	700	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
xylene (m/p)	1000	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
o-xylene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
styrene	100	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
bromofom	4	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	700	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
bromobenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
n-propyl benzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
2-chlorotoluene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
4-chlorotoluene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
tert-butylbenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
sec-butylbenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	600	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
4-isopropyltoluene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	75	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	600	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
n-butylbenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
hexachlorobutadiene	1	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
naphthalene	300	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene		50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	70	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
Acetone	6000	100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
carbon disulfide	700	50.0 U	25.0 U	105 U	NS	NS	NS	42.0 U	5.0 U	25.0 U	25.0 U	25.0 U	5.0 U	5.0 U
2-butanone (MEK)	300	100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	10	100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
2-hexanone		100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether		100.0 U	50.0 U	210 U	NS	NS	NS	84.0 U	10.0 U	50.0 U	50.0 U	50.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	242	203	82.7	NS	NS	NS	260	226	96.7	72.1	56.4	66.8	254
Ethane	NA	4.0 U	4.0 U	4.0 U	NS	NS	NS	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.0 U	2.0 U
Ethene	NA	5.0 U	5.0 U	5.0 U	NS	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004 J	0.003 J	0.01 U	0.008 U	0.0083 J	NS	0.009 U	0.03 U	0.0020 J	0.008 U	0.008 U	0.0039 J	0.0040 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	6220 D	NS	NS	5640 D	NS	6520 D	NS	NS	NS	NS	NS	NS
Manganese	50	NS	74.6 D	NS	NS	56.2 D	NS	82.1 D	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	2.5 U	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	5210	NS	NS	NS	NS	NS	NS	NS	NS
Manganese		NS	NS	NS	NS	51.5	NS	NS	NS	NS	NS	NS	NS	NS
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium		NS	NS	NS	NS	3290	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium		NS	NS	NS	NS	4910	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	NS	2.37	2.82	2.01	2.34	NS	NS
Alkalinity as CaCO3	NA	NS	NS	NS	NS	2.0 U	NS	2.57	NS	NS	NS	NS		

Table D.2. BMW-1I: Analytical and Field Parameter Results

Sample ID	NJ Higher of	BMW-1I	BMW-1I	BMW-1I	BMW-1I	BMW-1I
Lab Sample No.	POLs and	8534-10	8539-13	8649-16	8665-19	8678-5
Sampling Date	GW Quality	10/27/2011	11/10/2011	3/27/2012	4/18/2012	5/2/2012
Time (days)		-45	-32	106	128	142
Matrix	2005 Criteria	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	500 U	25.0 U	5.0 U	NS	NS
chloromethane		500 U	25.0 U	5.0 U	NS	NS
vinyl chloride	1	500 U	25.0 U	5.0 U	NS	NS
bromomethane	10	500 U	25.0 U	5.0 U	NS	NS
chloroethane		500 U	25.0 U	5.0 U	NS	NS
trichlorofluoromethane	2000	500 U	25.0 U	5.0 U	NS	NS
1,1-dichloroethylene	1	500 U	25.0 U	1.1 J	NS	NS
methylene chloride	3	500 U	25.0 U	5.0 U	NS	NS
trans-1,2-dichloroethylene	100	500 U	25.0 U	5.0 U	NS	NS
1,1-dichloroethane	50	500 U	25.0 U	5.0 U	NS	NS
2,2-dichloropropane		500 U	25.0 U	5.0 U	NS	NS
cis 1,2-dichloroethylene	70	105 J	9.9 J	50.3	NS	NS
bromochloromethane		500 U	25.0 U	5.0 U	NS	NS
chloroform	70	500 U	25.0 U	5.0 U	NS	NS
1,1,1-trichloroethane	30	500 U	25.0 U	5.0 U	NS	NS
carbon tetrachloride	1	500 U	25.0 U	5.0 U	NS	NS
1,1-dichloropropene		500 U	25.0 U	5.0 U	NS	NS
benzene	1	500 U	25.0 U	5.0 U	NS	NS
1,2-dichloroethane	2	500 U	25.0 U	5.0 U	NS	NS
trichloroethylene	1	2650 D	2560 D	1140 D	NS	NS
1,2-dichloropropane	1	500 U	25.0 U	5.0 U	NS	NS
dibromomethane		500 U	25.0 U	5.0 U	NS	NS
bromodichloromethane	1	500 U	25.0 U	5.0 U	NS	NS
cis-1,3-dichloropropene	1	500 U	25.0 U	5.0 U	NS	NS
toluene	600	500 U	25.0 U	5.0 U	NS	NS
trans-1,3-dichloropropene	1	500 U	25.0 U	5.0 U	NS	NS
1,1,2-trichloroethane	3	500 U	25.0 U	5.0 U	NS	NS
tetrachloroethylene	1	500 U	25.0 U	5.0 U	NS	NS
1,3-dichloropropane		500 U	25.0 U	5.0 U	NS	NS
dibromochloromethane	1	500 U	25.0 U	5.0 U	NS	NS
1,2-dibromoethane		500 U	25.0 U	5.0 U	NS	NS
chlorobenzene	50	500 U	25.0 U	5.0 U	NS	NS
1,1,1,2-tetrachloroethane	1	500 U	25.0 U	5.0 U	NS	NS
ethylbenzene	700	500 U	25.0 U	5.0 U	NS	NS
xylene (m/p)	1000	500 U	25.0 U	5.0 U	NS	NS
o-xylene		500 U	25.0 U	5.0 U	NS	NS
styrene	100	500 U	25.0 U	5.0 U	NS	NS
bromoform	4	500 U	25.0 U	5.0 U	NS	NS
isopropyl benzene (cumene)	700	500 U	25.0 U	5.0 U	NS	NS
bromobenzene		500 U	25.0 U	5.0 U	NS	NS
1,1,2,2-tetrachloroethane	1	500 U	25.0 U	5.0 U	NS	NS
1,2,3-trichloropropane	0.03	500 U	25.0 U	5.0 U	NS	NS
n-propyl benzene		500 U	25.0 U	5.0 U	NS	NS
2-chlorotoluene		500 U	25.0 U	5.0 U	NS	NS
4-chlorotoluene		500 U	25.0 U	5.0 U	NS	NS
1,3,5-trimethylbenzene		500 U	25.0 U	5.0 U	NS	NS
tert-butylbenzene		500 U	25.0 U	5.0 U	NS	NS
1,2,4-trimethylbenzene		500 U	25.0 U	5.0 U	NS	NS
sec-butylbenzene		500 U	25.0 U	5.0 U	NS	NS
1,3-dichlorobenzene	600	500 U	25.0 U	5.0 U	NS	NS
4-isopropyltoluene		500 U	25.0 U	5.0 U	NS	NS
1,4-dichlorobenzene	75	500 U	25.0 U	5.0 U	NS	NS
1,2-dichlorobenzene	600	500 U	25.0 U	5.0 U	NS	NS
n-butylbenzene		500 U	25.0 U	5.0 U	NS	NS
1,2-dibromo-3-chloropropane	0.02	500 U	25.0 U	5.0 U	NS	NS
1,2,4-trichlorobenzene	9	500 U	25.0 U	5.0 U	NS	NS
hexachlorobutadiene	1	500 U	25.0 U	5.0 U	NS	NS
naphthalene	300	500 U	25.0 U	5.0 U	NS	NS
1,2,3-trichlorobenzene		500 U	25.0 U	5.0 U	NS	NS
Methyl tertiary butyl ether	70	500 U	25.0 U	5.0 U	NS	NS
Acetone	6000	1000 U	50.0 U	10.0 U	NS	NS
carbon disulfide	700	500 U	25.0 U	5.0 U	NS	NS
2-butanone (MEK)	300	1000 U	50.0 U	10.0 U	NS	NS
tetrahydrofuran (THF)	10	1000 U	50.0 U	10.0 U	NS	NS
4-methyl-2-pentanone (MIBK)		1000 U	50.0 U	10.0 U	NS	NS
2-hexanone		1000 U	50.0 U	10.0 U	NS	NS
2-chloroethyl vinyl ether		1000 U	50.0 U	10.0 U	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	239	279	43.7	NS	NS
Ethane	NA	0.56 J	0.43 J	4.0 U	NS	NS
Ethene	NA	0.46 J	5.0 U	5.0 U	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.005 J	0.006 J	0.012	0.008 U	0.0086 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	18200 D	NS	NS	8930 D
Manganese	50	NS	156 D	NS	NS	76.9 D
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	8600
Manganese		NS	NS	NS	NS	76.5
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium		NS	NS	NS	NS	19500
Magnesium		NS	NS	NS	NS	5320
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Alkalinity as CaCO ₃	NA	NS	NS	NS	NS	2.0 U
Sulfide	NA	NS	NS	NS	NS	1.6
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS
Chloride	250	21.8	35.7	15.4	NS	18.4
Nitrite as N	1	0.2 U	0.2 U	0.2 U	NS	0.2 U
Sulfate as SO ₄	250	96.9 E	262 E	84.5 D	NS	63.1 E
Bromide	NA	1.81	1.08	0.53	NS	0.95
Nitrate as N	10	0.2 U	0.2 U	0.2 U	NS	0.2 U
O-Phosphate as P	NA	0.2 U	0.2 U	0.2 U	NS	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS
Acetic Acid	NA	NS	1.28	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS
FIELD PARAMETERS						
pH (SU)	NA	5.86	5.97	6.18	6.10	6.16
Temperature (°C)	NA	16.39	16.95	13.72	14.58	14.17
Dissolved Oxygen (DO; mg/L)	NA	0.39	10.51	0.51	0.50	0.68
Redox Potential (ORP; mV)	NA	-52.3	-89.6	-26.3	-42.3	-28.8
Conductivity (µS/cm)	NA	1206	863	606	572	874
Depth to Water (ft-btoc)	NA	16.05	14.8	9.1	8.14	12.30

Table D.3. BMW-1D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	BMW-1D	BMW-1D	BMW-1D	BMW-1D	BMW-1D
Lab Sample No.	PQLs and	8534-9	8539-14	8649-17	8665-20	8678-6
Sampling Date	GW Quality	10/27/2011	11/9/2011	3/27/2012	4/18/2012	5/2/2012
Time (days)		-45	-33	106	128	142
Matrix	2005 Criteria	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	5.0 U	5.0 U	5.0 U	NS	NS
chloromethane		5.0 U	5.0 U	5.0 U	NS	NS
vinyl chloride	1	5.0 U	5.0 U	5.0 U	NS	NS
bromomethane	10	5.0 U	5.0 U	5.0 U	NS	NS
chloroethane		0.7 J	5.0 U	5.0 U	NS	NS
trichlorofluoromethane	2000	5.0 U	5.0 U	5.0 U	NS	NS
1,1-dichloroethylene	1	5.0 U	5.0 U	5.0 U	NS	NS
methylene chloride	3	5.0 U	5.0 U	5.0 U	NS	NS
trans-1,2-dichloroethylene	100	5.0 U	5.0 U	5.0 U	NS	NS
1,1-dichloroethane	50	5.0 U	5.0 U	5.0 U	NS	NS
2,2-dichloropropane		5.0 U	5.0 U	5.0 U	NS	NS
cis-1,2-dichloroethylene	70	1.8 J	1.8 J	5.5	NS	NS
bromochloromethane		5.0 U	5.0 U	5.0 U	NS	NS
chloroform	70	5.0 U	5.0 U	5.0 U	NS	NS
1,1,1-trichloroethane	30	5.0 U	5.0 U	5.0 U	NS	NS
carbon tetrachloride	1	5.0 U	5.0 U	5.0 U	NS	NS
1,1-dichloropropene		5.0 U	5.0 U	5.0 U	NS	NS
benzene	1	5.0 U	5.0 U	5.0 U	NS	NS
1,2-dichloroethane	2	5.0 U	5.0 U	5.0 U	NS	NS
trichloroethylene	1	12.1	20.7	50.1	NS	NS
1,2-dichloropropane	1	5.0 U	5.0 U	5.0 U	NS	NS
dibromomethane		5.0 U	5.0 U	5.0 U	NS	NS
bromodichloromethane	1	5.0 U	5.0 U	5.0 U	NS	NS
cis-1,3-dichloropropene	1	5.0 U	5.0 U	5.0 U	NS	NS
toluene	600	5.0 U	5.0 U	5.0 U	NS	NS
trans-1,3-dichloropropene	1	5.0 U	5.0 U	5.0 U	NS	NS
1,1,2-trichloroethane	3	5.0 U	5.0 U	5.0 U	NS	NS
tetrachloroethylene	1	5.0 U	5.0 U	5.0 U	NS	NS
1,3-dichloropropane		5.0 U	5.0 U	5.0 U	NS	NS
dibromochloromethane	1	5.0 U	5.0 U	5.0 U	NS	NS
1,2-dibromoethane		5.0 U	5.0 U	5.0 U	NS	NS
chlorobenzene	50	5.0 U	5.0 U	5.0 U	NS	NS
1,1,1,2-tetrachloroethane	1	5.0 U	5.0 U	5.0 U	NS	NS
ethylbenzene	700	5.0 U	5.0 U	5.0 U	NS	NS
xlenes (m/p)	1000	5.0 U	5.0 U	5.0 U	NS	NS
o-xylene		5.0 U	5.0 U	5.0 U	NS	NS
styrene	100	5.0 U	5.0 U	5.0 U	NS	NS
bromoform	4	5.0 U	5.0 U	5.0 U	NS	NS
isopropyl benzene (cumene)	700	5.0 U	5.0 U	5.0 U	NS	NS
bromobenzene		5.0 U	5.0 U	5.0 U	NS	NS
1,1,2,2-tetrachloroethane	1	5.0 U	5.0 U	5.0 U	NS	NS
1,2,3-trichloropropane	0.03	5.0 U	5.0 U	5.0 U	NS	NS
n-propyl benzene		5.0 U	5.0 U	5.0 U	NS	NS
2-chlorotoluene		5.0 U	5.0 U	5.0 U	NS	NS
4-chlorotoluene		5.0 U	5.0 U	5.0 U	NS	NS
1,3,5-trimethylbenzene		5.0 U	5.0 U	5.0 U	NS	NS
tert-butylbenzene		5.0 U	5.0 U	5.0 U	NS	NS
1,2,4-trimethylbenzene		5.0 U	5.0 U	5.0 U	NS	NS
sec-butylbenzene		5.0 U	5.0 U	5.0 U	NS	NS
1,3-dichlorobenzene	600	5.0 U	5.0 U	5.0 U	NS	NS
4-isopropyltoluene		5.0 U	5.0 U	5.0 U	NS	NS
1,4-dichlorobenzene	75	5.0 U	5.0 U	5.0 U	NS	NS
1,2-dichlorobenzene	600	5.0 U	5.0 U	5.0 U	NS	NS
n-butylbenzene		5.0 U	5.0 U	5.0 U	NS	NS
1,2-dibromo-3-chloropropane	0.02	5.0 U	5.0 U	5.0 U	NS	NS
1,2,4-trichlorobenzene	9	5.0 U	5.0 U	5.0 U	NS	NS
hexachlorobutadiene	1	5.0 U	5.0 U	5.0 U	NS	NS
naphthalene	300	5.0 U	5.0 U	5.0 U	NS	NS
1,2,3-trichlorobenzene		5.0 U	5.0 U	5.0 U	NS	NS
Methyl tertiary butyl ether	70	5.0 U	5.0 U	5.0 U	NS	NS
Acetone	6000	2.0 J	10.0 U	10.0 U	NS	NS
carbon disulfide	700	5.0 U	5.0 U	5.0 U	NS	NS
2-butanone (MEK)	300	4.9 J	10.0 U	10.0 U	NS	NS
tetrahydrofuran (THF)	10	2.0 J	10.0 U	10.0 U	NS	NS
4-methyl-2-pentanone (MIBK)		10.0 U	10.0 U	10.0 U	NS	NS
2-hexanone		10.0 U	10.0 U	10.0 U	NS	NS
2-chloroethyl vinyl ether		10.0 U	10.0 U	10.0 U	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	612 D	389 D	197 D	NS	NS
Ethane	NA	0.48 J	4.0 U	4.0 U	NS	NS
Ethene	NA	5.0 U	5.0 U	5.0 U	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004 J	0.002 U	0.01 U	0.008 U	0.0086 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	9800 D	NS	NS	23000 D
Manganese	50	NS	96.1 D	NS	NS	126 D
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	23500
Manganese		NS	NS	NS	NS	129
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium		NS	NS	NS	NS	23700
Magnesium		NS	NS	NS	NS	5400
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Alkalinity as CaCO3	NA	NS	NS	NS	NS	2.0 U
Sulfide	NA	NS	NS	NS	NS	1.44
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS
Chloride	250	42.3	18.0	21.9	NS	22.9
Nitrite as N	1	0.2 U	0.2 U	0.2 U	NS	0.2 U
Sulfate as SO ₄	250	321 ED	97.8 ED	91.9 D	NS	81.8 ED
Bromide	NA	1.04	1.07	1.43	NS	1.92
Nitrate as N	10	0.2 U	0.2 U	0.2 U	NS	0.2 U
O-Phosphate as P	NA	0.2 U	0.2 U	0.2 U	NS	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS
FIELD PARAMETERS						
pH (SU)	NA	5.63	5.92	5.62	5.26	5.72
Temperature (°C)	NA	16.16	16.27	15.05	14.60	14.36
Dissolved Oxygen (DO; mg/L)	NA	0.27	7.25	0.79	0.73	0.93
Redox Potential (ORP; mV)	NA	39.2	-41.3	32.4	7.8	48.2
Conductivity (µS/cm)	NA	507	462	487	397	752
Depth to Water (ft-btoc)	NA	9.98	9.81	9.79	NS	10.35

Table D.4. PMW-1S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S	PMW-1S
Lab Sample No.	PQLs and	8534-6	8538-1	8543-1	8546-1	8547-1	8550-1	8551-1	8647-4	8708-15	8713-18
Sampling Date	GW Quality	10/27/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	6/7/2012	6/11/2012
Time (days)		-45	-33	-26	-24	-21	-19	-14	105	178	182
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
chloromethane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
vinyl chloride	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
bromomethane	10	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
chloroethane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
trichlorofluoromethane	2000	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1-dichloroethylene	1	50.0 U	3.6 J	NS	NS	NS	NS	NS	4.1 J	NS	NS
methylene chloride	3	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	21.0 U	NS	NS	NS	NS	NS	1.5 J	NS	NS
1,1-dichloroethane	50	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
2,2-dichloropropane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
cis 1,2-dichloroethylene	70	132 D	125 D	NS	NS	NS	NS	NS	156	NS	NS
bromochloromethane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
chloroform	70	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1,1-trichloroethane	30	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
carbon tetrachloride	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1-dichloropropene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
benzene	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2-dichloroethane	2	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
trichloroethylene	1	11800 D	9990 D	NS	NS	NS	NS	NS	8920 D	NS	NS
1,2-dichloropropane	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
dibromomethane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
bromodichloromethane	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
cis-1,3-dichloropropene	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
toluene	600	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
trans-1,3-dichloropropene	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1,2-trichloroethane	3	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
tetrachloroethylene	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,3-dichloropropane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
dibromochloromethane	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2-dibromoethane		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
chlorobenzene	50	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
ethylbenzene	700	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
xylene (m/p)	1000	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
o-xylene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
styrene	100	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
bromoform	4	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
isopropyl benzene (cumene)	700	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
bromobenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
n-propyl benzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
2-chlorotoluene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
4-chlorotoluene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,3,5-trimethylbenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
tert-butylbenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2,4-trimethylbenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
sec-butylbenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,3-dichlorobenzene	600	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
4-isopropyltoluene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,4-dichlorobenzene	75	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2-dichlorobenzene	600	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
n-butylbenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
hexachlorobutadiene	1	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
naphthalene	300	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
1,2,3-trichlorobenzene		50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
Methyl tertiary butyl ether	70	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
Acetone	6000	100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
carbon disulfide	700	50.0 U	21.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS
2-butanone (MEK)	300	100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
tetrahydrofuran (THF)	10	100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
2-hexanone		100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
2-chloroethyl vinyl ether		100.0 U	42.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	77.8	87.2	NS	NS	NS	NS	NS	94.6	NS	NS
Ethane	NA	1.05	4.0	U	NS	NS	NS	NS	4.0	U	NS
Ethene	NA	0.46	5.0	U	NS	NS	NS	NS	5.0	U	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004	0.009	U	NS	NS	NS	NS	0.01	U	0.003
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5900	D	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	58.8	D	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2	0.2	U	NS	NS	NS	NS	NS	NS	NS
Chloride	250	17.3	17.5	NS	NS	NS	NS	NS	15.8	11.4	12.1
Nitrite as N	1	0.2	0.2	U	NS	NS	NS	NS	0.2	U	0.2
Sulfate as SO ₄	250	68.0	66.9	E	NS	NS	NS	NS	61.8	E	59.5
Bromide	NA	0.52	0.47	9.92	12.6	12.5	0.48	12.9	1.59	1.43	1.70
Nitrate as N	10	0.2	0.2	U	NS	NS	NS	NS	0.2	U	0.2
O-Phosphate as P	NA	0.2	0.2	U	NS	NS	NS	NS	0.2	U	0.2
FIELD PARAMETERS											
pH (SU)	NA	4.64	4.34	NS	NS	NS	NS	NS	4.76	4.74	4.86
Temperature (°C)	NA	16.25	16.24	NS	NS	NS	NS	NS	13.76	15.19	15.54
Dissolved Oxygen (DO; mg/L)	NA	0.14	0.7	NS	NS	NS	NS	NS	0.81	0.70	2.21
Redox Potential (ORP; mV)	NA	102.4	-19.3	NS	NS	NS	NS	NS	72.1	51.7	3.9
Conductivity (µS/cm)	NA	240	232	NS	NS	NS	NS	NS	242	205	199
Depth to Water (ft-btoc)	NA	6.85	6.6	NS	NS	NS	NS	NS	7.17	NS	7.66

Table D.4. PMW-1S: Analytical and Field Parameter Results

Sample ID	PMW-1S	PMW-1S	PMW-1S
Lab Sample No.	8717-1		
Sampling Date	6/13/2012	6/15/2012	6/19/2012
Time (days)	184	186	190
Matrix	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS
chloromethane	NS	NS	NS
vinyl chloride	NS	NS	NS
bromomethane	NS	NS	NS
chloroethane	NS	NS	NS
trichlorofluoromethane	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS
methylene chloride	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS
1,1-dichloroethane	NS	NS	NS
2,2-dichloropropane	NS	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS
bromochloromethane	NS	NS	NS
chloroform	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS
carbon tetrachloride	NS	NS	NS
1,1-dichloropropene	NS	NS	NS
benzene	NS	NS	NS
1,2-dichloroethane	NS	NS	NS
trichloroethylene	NS	NS	NS
1,2-dichloropropane	NS	NS	NS
dibromomethane	NS	NS	NS
bromodichloromethane	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS
toluene	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS
tetrachloroethylene	NS	NS	NS
1,3-dichloropropane	NS	NS	NS
dibromochloromethane	NS	NS	NS
1,2-dibromoethane	NS	NS	NS
chlorobenzene	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS
ethylbenzene	NS	NS	NS
xylene (m/p)	NS	NS	NS
o-xylene	NS	NS	NS
styrene	NS	NS	NS
bromoform	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS
bromobenzene	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS
n-propyl benzene	NS	NS	NS
2-chlorotoluene	NS	NS	NS
4-chlorotoluene	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS
tert-butylbenzene	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS
sec-butylbenzene	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS
4-isopropyltoluene	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS
n-butylbenzene	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS
hexachlorobutadiene	NS	NS	NS
naphthalene	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS
Acetone	NS	NS	NS
carbon disulfide	NS	NS	NS
2-butanone (MEK)	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS
2-hexanone	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L
Methane	NS	NS	NS
Ethane	NS	NS	NS
Ethene	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L
Iron	NS	NS	NS
Manganese	NS	NS	NS
Arsenic	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS
Chloride	NS	NS	NS
Nitrite as N	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS
Bromide	1.41	1.77	1.64
Nitrate as N	NS	NS	NS
O-Phosphate as P	NS	NS	NS
FIELD PARAMETERS			
pH (SU)	4.86	4.89	4.86
Temperature (°C)	15.31	15.85	15.53
Dissolved Oxygen (DO; mg/L)	3.91	2.18	0.94
Redox Potential (ORP; mV)	-47.5	-30.7	-41.4
Conductivity (µS/cm)	203	204	204
Depth to Water (ft-btoc)	7.60	7.67	7.67

Table D.5. PMW-11: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11	PMW-11
Lab Sample No.	POLs and	8534-7	8538-2	8546-2	8547-2	8550-2	8551-2	8647-5	8708-16	8713-19	8717-2		
Sampling Date	GW Quality	10/27/2011	11/9/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time (days)		-45	-33	-24	-21	-19	-14	105	178	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloromethane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroethane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	3.5 JD	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
methylene chloride	3	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis 1,2- dichloroethylene	70	149 D	67.2 D	NS	NS	NS	NS	91.1 JD	NS	NS	NS	NS	NS
bromochloromethane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroform	70	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
benzene	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichloroethylene	1	6730 D	2810 D	NS	NS	NS	NS	5270 D	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
dibromomethane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
toluene	600	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3-dichloropropane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
dibromochloromethane	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dibromoethane		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
xylenes (m/p)	1000	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
o-xylene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
styrene	100	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromoform	4	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromobenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
n-propyl benzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2-chlorotoluene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
4-chlorotoluene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
tert-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
sec-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
n-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	10.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
2-hexanone		100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	20.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	130	46.2	NS	NS	NS	NS	452	NS	NS	NS	NS	NS
Ethane	NA	0.53	4.0 U	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS
Ethene	NA	0.52	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.055	0.009 U	NS	NS	NS	NS	0.01 U	0.009 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	3210 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	61.2 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.27	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	14.9	6.04	NS	NS	NS	NS	12.1	16.5	16.3	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	93.3	92.1	E	NS	NS	NS	57.9	56.7	56.3	E	NS	NS
Bromide	NA	0.69	0.34	0.46	0.52	0.27	0.33	1.34	1.26	1.53	1.62	1.71	1.70
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	NA	5.67	5.83	NS	NS	NS	NS	5.95	5.83	5.90	5.86	5.82	5.77
Temperature (°C)	NA	16.47	16.13	NS	NS	NS	NS	13.99	15.89	16.03	15.67	16.40	16.50
Dissolved Oxygen (DO; mg/L)	NA	0.26	5.1	NS	NS	NS	NS	0.80	0.62	1.83	3.05	1.77	1.24
Redox Potential (ORP; mV)	NA	37.10	15.4	NS	NS	NS	NS	25.2	-3.6	2.3	-43.0	-16.3	-24.1
Conductivity (µS/cm)	NA	514	602	NS	NS	NS	NS	448	380	358	339	333	333
Depth to Water (ft-btoc)	NA	10.11	9.40	NS	NS	NS	NS	12.76	NS	11.80	11.00	10.82	10.68

Table D.6. PMW-2S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S	PMW-2S
Lab Sample No.	POLs and	8534-2	8538-3	8546-3	8547-3	8550-3	8551-3	8647-6	8713-7	8717-3		
Sampling Date	GW Quality	10/27/2011	11/9/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time (days)		-45	-33	-24	-21	-19	-14	105	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloromethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
vinyl chloride	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromomethane	10	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
methylene chloride	3	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	157 D	129 D	NS	NS	NS	NS	107 D	NS	NS	NS	NS
bromochloromethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroform	70	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
benzene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichloroethylene	1	13100 D	12000 D	NS	NS	NS	NS	9340 D	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tribromomethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
toluene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichloropropane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tribromochloromethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromomethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chlorobenzene	50	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
ethylbenzene	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
xylene (m/p)	1000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
o-xylene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
styrene	100	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromofom	4	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromobenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-propyl benzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tert-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
sec-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
naphthalene	300	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Acetone	6000	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
carbon disulfide	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-hexanone		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	92.3	89.8	NS	NS	NS	NS	84.2	NS	NS	NS	NS
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.006 J	0.002 J	NS	NS	NS	NS	0.01 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5560 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	55.1 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	21.0	18.6	NS	NS	NS	NS	14.6	12.0	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	79.0 E	75.9 E	NS	NS	NS	NS	60.1 E	62.3 E	NS	NS	NS
Bromide	NA	0.54	0.48	12.3	11.7	4.53	12.1	1.49	1.89	1.46	1.71	1.99
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	4.66	4.43	NS	NS	NS	NS	4.63	4.33	4.44	4.41	4.49
Temperature (°C)	NA	16.51	16.44	NS	NS	NS	NS	13.76	15.30	14.67	15.08	14.90
Dissolved Oxygen (DO; mg/L)	NA	0.38	4.64	NS	NS	NS	NS	0.86	3.92	4.81	5.06	2.31
Redox Potential (ORP; mV)	NA	-14.0	51.3	NS	NS	NS	NS	65.2	-1.1	8.0	-34.0	-10.8
Conductivity (µS/cm)	NA	281	236	NS	NS	NS	NS	228	197	198	199	201.00
Depth to Water (ft-btoc)	NA	6.79	6.91	NS	NS	NS	NS	7.32	7.74	7.65	8.86	7.83

Table D.7. PMW-2I: Analytical and Field Paramter Data

Sample ID	NJ Higher of	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I	PMW-2I
Lab Sample No.	POLs and	8534-5	8538-4	8546-4	8547-4	8550-4	8551-4	8647-7	8713-8	8717-4		
Sampling Date	GW Quality	10/27/2011	11/9/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time		-45	-33	-24	-21	-19	-14	105	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloromethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
vinyl chloride	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromomethane	10	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	7.6 D	NS	NS	NS	NS	105 U	NS	NS	NS	NS
methylene chloride	3	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	223 D	203 D	NS	NS	NS	NS	183 D	NS	NS	NS	NS
bromochloromethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroform	70	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
benzene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichloroethylene	1	16400 D	16000 D	NS	NS	NS	NS	14100 D	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dibromomethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
toluene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichloropropane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromomethane		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chlorobenzene	50	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
ethylbenzene	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
xlenes (m/p)	1000	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
o-xylene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
styrene	100	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromoform	4	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromobenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-propyl benzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tert-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
sec-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
naphthalene	300	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Acetone	6000	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
Carbon disulfide	700	50.0 U	42.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-hexanone		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	84.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	174	176	NS	NS	NS	NS	223	NS	NS	NS	NS
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	0.36 J	NS	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.016	0.004 J	NS	NS	NS	NS	0.01 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	11600 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	131 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	21.0	21.5	NS	NS	NS	NS	16.2	16.3	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	88.4 E	83.4 E	NS	NS	NS	NS	71.4 E	62.4 E	NS	NS	NS
Bromide	NA	0.78	0.71	2.86	3.06	2.31	3.32	1.13	2.22	2.05	2.43	2.43
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.37	5.18	NS	NS	NS	NS	5.47	4.99	4.99	4.96	4.99
Temperature (°C)	NA	16.31	16.16	NS	NS	NS	NS	13.97	15.42	14.93	15.55	15.06
Dissolved Oxygen (DO; mg/L)	NA	0.36	2.44	NS	NS	NS	NS	0.85	2.96	3.84	3.54	1.60
Redox Potential (ORP; mV)	NA	-60.6	-24.5	NS	NS	NS	NS	-11.8	-74.2	-61.7	-81.8	-75.5
Conductivity (µS/cm)	NA	387	319	NS	NS	NS	NS	379	236	234	237	237
Depth to Water (ft-btcc)	NA	8.36	8.39	NS	NS	NS	NS	9.11	9.40	9.61	9.40	9.33

Table D.8. PMW-3S: Analytical and Field Parameter Results

Sample ID	NJ Higher of PQLs and GW Quality	PMW-3S 8533-2	PMW-3S 8538-5	PMW-3S 8543-2	PMW-3S 8546-5	PMW-3S 8547-5	PMW-3S 8550-5	PMW-3S 8551-5	PMW-3S 12/6/2011	PMW-3S 8647-8	PMW-3S 8713-15
Lab Sample No.	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	3/26/2012	6/11/2012
Sampling Date											
Time		-46	-33	-26	-24	-21	-19	-14	-6	105	182
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
chloromethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
vinyl chloride	1	1.0 J	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
bromomethane	10	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
chloroethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
trichlorofluoromethane	2000	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,1-dichloroethylene	1	4.2 J	4.6 J	NS	NS	NS	NS	NS	NS	105 U	NS
methylene chloride	3	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
trans-1,2-dichloroethylene	100	2.0 J	1.6 J	NS	NS	NS	NS	NS	NS	105 U	NS
1,1-dichloroethane	50	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
2,2-dichloropropane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
cis-1,2-dichloroethylene	70	126	125	NS	NS	NS	NS	NS	NS	70.4 JD	NS
bromochloromethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
chloroform	70	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,1,1-trichloroethane	30	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
carbon tetrachloride	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,1-dichloropropene		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
benzene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,2-dichloroethane	2	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
trichloroethylene	1	6090 D	5680 D	NS	NS	NS	NS	NS	NS	6980 D	NS
1,2-dichloropropane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
dibromomethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
bromodichloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
cis-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
toluene	600	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
trans-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,1,2-trichloroethane	3	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
tetrachloroethylene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,3-dichloropropane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
dibromochloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,2-dibromoethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
chlorobenzene	50	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
1,1,1,2-tetrachloroethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
ethylbenzene	700	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
xylenes (m/p)	1000	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
o-xylene		5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
styrene	100	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	105 U	NS
bromoform	4	5.0 U	5.0 U</								

Table D.8. PMW-3S: Analytical and Field Parameter Results

Sample ID	PMW-3S	PMW-3S	PMW-3S
Lab Sample No.	8717-5		
Sampling Date	6/13/2012	6/15/2012	6/19/2012
Time	184	186	190
Matrix	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS
chloromethane	NS	NS	NS
vinyl chloride	NS	NS	NS
bromomethane	NS	NS	NS
chloroethane	NS	NS	NS
trichlorofluoromethane	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS
methylene chloride	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS
1,1-dichloroethane	NS	NS	NS
2,2-dichloropropane	NS	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS
bromochloromethane	NS	NS	NS
chloroform	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS
carbon tetrachloride	NS	NS	NS
1,1-dichloropropene	NS	NS	NS
benzene	NS	NS	NS
1,2-dichloroethane	NS	NS	NS
trichloroethylene	NS	NS	NS
1,2-dichloropropane	NS	NS	NS
dibromomethane	NS	NS	NS
bromodichloromethane	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS
toluene	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS
tetrachloroethylene	NS	NS	NS
1,3-dichloropropane	NS	NS	NS
dibromochloromethane	NS	NS	NS
1,2-dibromoethane	NS	NS	NS
chlorobenzene	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS
ethylbenzene	NS	NS	NS
xylenes (m/p)	NS	NS	NS
o-xylene	NS	NS	NS
styrene	NS	NS	NS
bromoform	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS
bromobenzene	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS
n-propyl benzene	NS	NS	NS
2-chlorotoluene	NS	NS	NS
4-chlorotoluene	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS
tert-butylbenzene	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS
sec-butylbenzene	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS
4-isopropyltoluene	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS
n-butylbenzene	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS
hexachlorobutadiene	NS	NS	NS
naphthalene	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS
Acetone	NS	NS	NS
carbon disulfide	NS	NS	NS
2-butanone (MEK)	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS
2-hexanone	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L
Methane	NS	NS	NS
Ethane	NS	NS	NS
Ethene	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L
Iron	NS	NS	NS
Manganese	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS
Chloride	NS	NS	NS
Nitrite as N	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS
Bromide	2.54	3.07	3.63
Nitrate as N	NS	NS	NS
O-Phosphate as P	NS	NS	NS
FIELD PARAMETERS			
pH (SU)	4.33	4.27	4.30
Temperature (°C)	15.09	15.65	15.60
Dissolved Oxygen (DO; mg/L)	2.41	2.23	1.03
Redox Potential (ORP; mV)	44.3	31.0	26.0
Conductivity (µS/cm)	211	215	217
Depth to Water (ft-btoc)	7.65	7.73	7.64

Table D.9. PMW-3I: Analytical and Field Results

Sample ID	NJ Higher of	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I	PMWV-3I
Lab Sample No.	8533-6	8538-6	8538-6	8546-6	8547-6	8550-6	8551-6	8551-6	8551-6	8551-6	8551-6	8551-6	8551-6	8551-6	8551-6
Sampling Date	PQL and	11/28/2011	11/28/2011	11/18/2011	11/21/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011	11/23/2011
Time	GW Quality	-46	-33	-24	-21	-19	-14	-6	-6	-6	-6	-6	-6	-6	-6
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloromethane		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
vinyl chloride	1	1.6 J	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromomethane	10	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroethane		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethylene	117	15.4 J	NS	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
methylene chloride	3	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	2.1 J	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethane	50	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2,2-dichloropropane		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	238	245	NS	NS	NS	NS	NS	NS	257 D	NS	NS	NS	NS	NS
bromochloromethane		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroform	70	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
carbon tetrachloride		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloropropane	1	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
benzene	1	9.7 J	8.1 J	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dichloroethane	2	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichloroethylene	1	4150 D	5770 D	NS	NS	NS	NS	NS	NS	8050 D	NS	NS	NS	NS	NS
1,2-dichloropropane	1	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
dibromomethane		5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromodichloromethane	1	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
toluene	600	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	5.0 U	25.0 U	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
tetrachloroethylene	1	5.0 U	25.0 U	NS</											

Table D.10. PMW-3D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D	PMW-3D
Lab Sample No.	POLs and	8533-4	8538-7	8546-7	8547-7	8550-7	8551-7	8647-10	8713-17	8717-7		
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	6/13/2012	6/13/2012	6/15/2012	6/19/2012
Time		-46	-33	-24	-21	-19	-14	152	229	231	233	237
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
chloromethane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
vinyl chloride	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
bromomethane	10	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
chloroethane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
trichlorofluoromethane	2000	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1-dichloroethylene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
methylene chloride	3	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1-dichloroethane	50	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
2,2-dichloropropane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	2.0 J	1.6 J	NS	NS	NS	NS	3.9 J	NS	NS	NS	NS
bromochloromethane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
chloroform	70	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1,1-trichloroethane	30	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
carbon tetrachloride	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1-dichloropropene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
benzene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2-dichloroethane	2	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
trichloroethylene	1	15.3	10.4	NS	NS	NS	NS	73.3	NS	NS	NS	NS
1,2-dichloropropane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
dibromomethane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
bromodichloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
cis-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
toluene	600	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
trans-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1,2-trichloroethane	3	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
tetrachloroethylene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,3-dichloropropane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
dibromochloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2-dibromoethane		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
chlorobenzene	50	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
ethylbenzene	700	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
xylene (m/p)	1000	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
o-xylene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
styrene	100	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
bromoforn	4	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
isopropyl benzene (cumene)	700	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
bromobenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
n-propyl benzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
2-chlorotoluene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
4-chlorotoluene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,3,5-trimethylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
tert-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2,4-trimethylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
sec-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,3-dichlorobenzene	600	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
4-isopropyltoluene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,4-dichlorobenzene	75	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2-dichlorobenzene	600	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
n-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
hexachlorobutadiene	1	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
naphthalene	300	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
1,2,3-trichlorobenzene		5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
Methyl tertiary butyl ether	70	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
Acetone	6000	10.0 U	83.6	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
carbon disulfide	700	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
2-butanone (MEK)	300	5.0 U	1850 D	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
tetrahydrofuran (THF)	10	10.0 U	10.0 U	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		10.0 U	10.0 U	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
2-hexanone		10.0 U	10.0 U	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
2-chloroethyl vinyl ether		10.0 U	10.0 U	NS	NS	NS	NS	10.0 U	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	400	328	NS	NS	NS	NS	151	NS	NS	NS	NS
Ethane	NA	0.65 J	4.0 U	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.007 J	0.008 J	NS	NS	NS	NS	0.01 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	20600 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	137 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	25.7	21.3	NS	NS	NS	NS	17.4	20.1	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	98.0 E	86.7 E	NS	NS	NS	NS	81.7 E	61.4 E	NS	NS	NS
Bromide	NA	1.27	1.31	1.41	1.20	1.35	1.23	0.96	1.25	1.30	1.46	1.36
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	6.04	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	2.68	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.30	4.66	NS	NS	NS	NS	5.34	5.49	5.50	5.48	5.54
Temperature (°C)	NA	15.99	16.22	NS	NS	NS	NS	14.65	15.83	15.43	15.81	15.55
Dissolved Oxygen (DO; mg/L)	NA	0.29	0.37	NS	NS	NS	NS	0.74	2.38	2.15	1.93	0.79
Redox Potential (ORP; mV)	NA	25.0	-77.7	NS	NS	NS	NS	3.8	-40.3	-50.5	-62.4	-66.1
Conductivity (µS/cm)	NA	473	446	NS	NS	NS	NS	400	305	300	297	308
Depth to Water (ft-btoc)	NA	8.84	7.62	NS	NS	NS	NS	7.22	8.13	7.98	7.99	7.96

Table D.11. PMW-4S: Analytical and Field Parameter Results

Sample ID	NU Higher of	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S	PMW-4S
Lab Sample No.	POIs and	8533-3	8538-9	8543-3	8546-8	8547-8	8550-8	8551-8	8556-7	8561-1	8581-4	8596-1	8597-13	8652-8	8652-8	8652-8
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/18/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	12/12/2011	12/12/2012	2/7/2012	3/28/2012	4/3/2012		
Time		-46	-33	-26	-24	-21	-19	-14	-6	0	31	57	105	113		
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
chloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
vinyl chloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
bromomethane	10	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
chloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
trichlorofluoromethane	2000	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1-dichloroethylene	1	25.0 U	1.5 J	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
methylene chloride	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
trans-1,2-dichloroethylene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1-dichloroethane	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
2,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
cis-1,2-dichloroethylene	70	39.1	40.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	26.9	NS	NS
bromochloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
chloroform	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1-trichloroethane	30	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
carbon tetrachloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1-dichloropropene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
benzene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,2-dichloroethane	2	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
trichloroethylene	1	1030	1140	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1080	NS	NS
1,2-dichloropropane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS	NS
1,1,1,2-tetrachloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS</					

Table D.11. PMW-4S: Analytical and Field Parameter Results

[illegible]

Table D.11. PMW-4S: Analytical and Field Parameter Results

Sample ID	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S	PMWV-4S
Lab Sample No.	8837-5	8839-1	8840-2	8850-2	8852-3	8869-2	8876-2	8954-3	8977-3
Sampling Date	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	4/24/2013	6/11/2013
Time	294	295	296	298	316	339	358	499	547
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
vinyl chloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromomethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichlorofluoromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
methylene chloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis 1,2- dichloroethylene	NS	NS	NS	NS	64.6	NS	NS	54.1	NS
bromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroform	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
carbon tetrachloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
benzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichloroethylene	NS	NS	NS	NS	1130	NS	NS	1920	NS
1,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
dibromomethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromodichloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
toluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tetrachloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
dibromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromoethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
ethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
xylene (m/p)	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
o-xylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
styrene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromofom	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,3-trichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
n-propyl benzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
4-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3,5									

Table D.12. PMW-4I: Analytical and Field Parameter Results

Sample ID	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I
Lab Sample No.	8652-7	8665-2	8672-3	8678-2	8685-3	8689-3	8690-6	8698-3	8698-3	8713-2	8713-2	8717-9	8717-9
Sampling Date	4/3/2012	4/18/2012	4/25/2012	5/2/2012	5/11/2012	5/16/2012	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time	113	128	135	142	151	156	161	170	178	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m/p)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethane	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethene	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.008 U	0.008 U	0.008 U	0.0086 U	NS	NS	NS	0.022 U	0.009 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	3930 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	61.5 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	4170 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	62.1 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium	NS	NS	NS	6600	NS	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium	NS	NS	NS	3060	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO ₃	NS	NS	NS	2.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfide	NS	NS	NS	1.44	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	NS	NS	NS	11.9	12.3	13.1	12.2	12.2	11.7	11.1	NS	NS	NS
Nitrite as N	NS	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS	62.8 E	63.5 E	65.6 E	62.9 E	62.4 E	62.8 E	61.6 E	NS	NS	NS
Bromide	NS	NS	NS	3.89	4.00	3.95	4.06	4.36	3.82	3.51	3.43	3.42	6.45
Nitrate as N	NS	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NS	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	6.00	5.86	5.82	5.92	5.51	5.78	5.53	5.63	5.62	5.75	5.72	5.77	5.75
Temperature (°C)	13.45	13.88	13.82	14.01	14.78	15.22	14.95	15.90	13.53	17.05	16.10	16.22	16.79
Dissolved Oxygen (DO; mg/L)	0.13	0.62	0.17	0.83	0.97	0.24	0.33	5.93	0.79	1.10	0.25	0.68	0.10
Redox Potential (ORP; mV)	-54.7	-20.2	-9.1	-57.8	-32.9	-25.1	-19.9	-127.6	-46.2	7.9	-11.9	2.8	2.7
Conductivity (µS/cm)	369	360	292	606	362	323	328	340	326	307	3.4	315	326
Depth to Water (ft-bloc)	8.90	9.44	NS	NS	NS	NS	NS	NS	NS	10.30	10.45	11.05	10.51

Table D.12. PMW-4I: Analytical and Field Parameter Results

Sample ID	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I	PMW-4I
Lab Sample No.	8767-2	8837-6	8839-2	8840-4	8850-4	8852-4	8869-4	8876-3	8954-4	8977-4
Sampling Date	7/30/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	4/24/2013	6/11/2013
Time	231	294	295	296	298	316	339	358	499	547
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
vinyl chloride	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromomethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichlorofluoromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethylene	5.2	NS	NS	NS	NS	5.2 JD	NS	NS	3.6 JD	NS
methylene chloride	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,2-dichloroethylene	1.2 J	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2,2-dichloropropane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis 1,2-dichloroethylene	104	NS	NS	NS	NS	105 D	NS	NS	67.4 D	NS
bromochloromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroform	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1-trichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
carbon tetrachloride	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloropropene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
benzene	1.9 J	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichloroethylene	3600 D	NS	NS	NS	NS	3830 D	NS	NS	2790 D	NS
1,2-dichloropropane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1-trichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromodichloromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis-1,3-dichloropropene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
toluene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,3-dichloropropene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2-trichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tetrachloroethylene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3-dichloropropane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2-trichloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromochloromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromochloromethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1,2-tetrachloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
ethylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
xylene (m/p)	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
o-xylene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
styrene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromoform	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
isopropyl benzene (cumene)	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2,2-tetrachloroethane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,3-trichloropropane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
n-propyl benzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2-chlorotoluene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
4-chlorotoluene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3,5-trimethylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tert-butylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,4-trimethylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
sec-butylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3-dichlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
4-isopropyltoluene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,4-dichlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dichlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
n-butylbenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromo-3-chloropropane	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,4-trichlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
hexachlorobutadiene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
naphthalene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,3-trichlorobenzene	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
Methyl tertiary butyl ether	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
Acetone	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
carbon disulfide	5.0 U	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2-butanone (MEK)	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
tetrahydrofuran (THF)	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
4-methyl-2-pentanone (MIBK)	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
2-hexanone	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
2-chloroethyl vinyl ether	10.0 U	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	99.2	NS	NS	NS	NS	133	NS	NS	24.2	NS
Ethane	4.0 U	NS	NS	NS	NS	1.2 J	NS	NS	4.0 U	NS
Ethene	5.0 U	NS	NS	NS	NS	2.4 J	NS	NS	5.0 U	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.009 U	0.009 U	0.0049 J	0.009 U	0.009 U	0.009 U	0.0048 J	0.009 U	0.008 U	0.0087
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	3950 D	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	46.5 D	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	2.35	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO ₃	NS	NS	NS	NS	NS	57.6	NS	NS	NS	NS
Sulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.19 J	NS	0.12 J	0.2 U	NS
Chloride	10.6	9.49	10.5	20.20	11.5	13.2	NS	17.2	10.4	NS
Nitrite as N	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
Sulfate as SO ₄	62.9 E	44.1 D	50.3 D	53.5 D	53.0 D	45.3 E	NS	39.8 E	26.9 E	NS
Bromide	5.42	8.30	7.43	67.1	24.3	24.9 D	NS	39.7	1.89	NS
Nitrate as N	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
O-Phosphate as P	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
FIELD PARAMETERS										
pH (SU)	5.66	5.62	5.65	5.45	5.60	5.91	5.87	5.75	5.83	NS
Temperature (°C)	17.82	17.97	17.71	18.12	17.74	17.01	13.59	16.08	13.17	NS
Dissolved Oxygen (DO; mg/L)	0.16	0.63	6.44	0.32	0.24	0.19	0.40	0.25	0.49	NS
Redox Potential (ORP; mV)	-209.4	0.6	33.0	72.5	17.5	-98.4	-42	-127.8	-16.1	NS
Conductivity (µS/cm)	316	276	292	361	270	306	251	368	189	NS
Depth to Water (ft-btoc)	NS	11.80	11.20	7.4	7.78	12.00	7.28	10.37	10.82	NS

Table D.13. PMW-4D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D
Lab Sample No.	POLs and	8533-8	8538-10	8543-5	8546-10	8547-10	8550-11	8551-10	8556-9	8561-3	8581-6	8596-3	8647-14	8652-6
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	12/12/2011	1/12/2012	2/7/2012	3/26/2012	4/3/2012
Time		-46	-33	-26	-24	-21	-19	-14	-6	0	31	57	105	113
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethylene	1	50.0 U	5.6 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
cis-1,2-dichloroethylene	70	159 D	144 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	37.7 D	NS
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trichloroethylene	1	9730 D	9990 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	1900 D	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
xylene (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromoforn	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	174	168	NS	NS	NS	NS	NS	NS	NS	NS	NS	12.9	NS
Ethane	NA	0.79 J	0.66 J	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.0 U	NS
Ethene	NA	0.59 J	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.0063 J	0.0046 J	NS	NS	NS	NS	NS	NS	0.0037 J	0.008 U	0.008 U	88.3	0.008 U
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	12700 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	104 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CATIONS		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	NS	3.63	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NA	NS	NS	NS	NS	NS	NS	NS	3.72	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfide	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	19.3	19.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.30	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
Sulfate as SO4	250	91.3 E	91.4 E	NS	NS	NS	NS	NS	NS	NS	NS	NS	46.1 E	NS
Bromide	NA	0.37	0.70	9.36	11.8	5.76	3.96	15.1	9.03	NS	NS	NS	1.69	NS
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS												

Table D.13. PMW-4D: Analytical and Field Parameter Results

[illegible]

Table D.13. PMW-4D: Analytical and Field Parameter Results

Sample ID	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D	PMW-4D
Lab Sample No.	8837-7	8839-3	8840-3	8850-3	8852-5	8869-3	8876-4	8954-5	8977-5
Sampling Date	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	4/24/2013	6/11/2013
Time	294	295	296	298	316	339	358	499	547
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
vinyl chloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromomethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichlorofluoromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
methylene chloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	73.8 D	NS	NS	49.9 D	NS
bromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chloroform	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
carbon tetrachloride	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
benzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trichloroethylene	NS	NS	NS	NS	4200 D	NS	NS	3000 D	NS
1,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tribromomethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromodichloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
toluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tetrachloroethylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tribromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromoethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
chlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
ethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
xylene (m/p)	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
o-xylene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
styrene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromoform	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
bromobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,3-trichloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
n-propyl benzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
4-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
tert-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
sec-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,3-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
4-isopropyltoluene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,4-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
n-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
hexachlorobutadiene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
naphthalene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
Acetone	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
carbon disulfide	NS	NS	NS	NS	42.0 U	NS	NS	25.0 U	NS
2-butanone (MEK)	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
2-hexanone	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	84.0 U	NS	NS	50.0 U	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	157	NS	NS	30.3	NS
Ethane	NS	NS	NS	NS	1.9 J	NS	NS	4.0 U	NS
Ethene	NS	NS	NS	NS	3.5 J	NS	NS	5.0 U	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.009 U	0.0033 J	0.009 U	0.0059 J	0.009 U	0.012	0.0095	0.0044 J	0.0076 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	7380 D	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	64.7 D	NS	NS	NS	NS
Arsenic	NS	NS	NS	NS	2.5 U	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium	NS	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	1.41 J	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO ₃	NS	NS	NS	NS	8.32	NS	NS	NS	NS
Sulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	1.0 U	1.0 U	1.0 U	1.0 U	0.07 J	NS	0.10 J	0.2 U	NS
Chloride	14.5	13.5	8.51	13.0	14.0	NS	17.2	10.8	NS
Nitrite as N	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
Sulfate as SO ₄	54.2 D	65.0 D	29.2 D	60.5 D	37.0 E	NS	35.7 E	30.5 E	NS
Bromide	4.81	7.47	83.3	66.1	51.3	NS	14.3	1.76	NS
Nitrate as N	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
O-Phosphate as P	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS
FIELD PARAMETERS									
pH (SU)	4.64	4.70	NS	4.51	5.00	5.10	4.97	5.21	NS
Temperature (°C)	17.45	17.55	17.13	17.32	16.75	13.28	16.22	14.16	NS
Dissolved Oxygen (DO; mg/L)	0.55	5.42	0.21	0.26	0.17	0.47	0.23	0.48	NS
Redox Potential (ORP; mV)	21.4	54.7	62.2	38.7	-40.5	19.8	-81.0	35.2	NS
Conductivity (µS/cm)	206	217	49.2	255	249	154	202	136	NS
Depth to Water (ft-btoc)	9.90	9.40	7.52	7.78	10.51	7.32	9.95	9.19	NS

ND - No data; Recorded data was

Table D.14. PMW-5S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S
Lab Sample No.	POLs and	8533-5	8538-11	8543-6	8546-11	8547-11	8550-13	8551-11	8647-11	8652-5	8665-4	8678-8
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	4/3/2012	4/18/2012	5/2/2012
Time		-46	-33	-26	-24	-21	-19	-14	105	113	128	142
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
cis-1,2-dichloroethylene	70	135 D	80.2 D	NS	NS	NS	NS	NS	61.6 D	NS	NS	NS
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
trichloroethylene	1	8070 D	6850 D	NS	NS	NS	NS	NS	3800 D	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
tribromomethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,3-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
tribromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
xylene (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	21.0 U	NS	NS	NS
2-butanone (MEK)	300	63.6 J	50.0 U	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	28.0 J	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	NS	42.0 U	NS	NS	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	99.1	73.7	NS	NS	NS	NS	NS	30.8	NS	NS	NS
Ethane	NA	0.35 J	4.0 U	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS
Ethene	NA	0.36 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.280	0.003 J	NS	NS	NS	NS	NS	0.01 U	0.008 U	0.008 U	0.0086 U
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5960 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	95.7 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	18.1	14.1	NS	NS	NS	NS	NS	9.40	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	85.3 E	71.2 E	NS	NS	NS	NS	NS	42.0 E	NS	NS	NS
Bromide	NA	0.47	0.44	19.4	25.8	10.2	20.2	28.3	1.93	NS	NS	NS
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.12	4.32	NS	NS	NS	NS	NS	5.13	5.25	4.93	5.16
Temperature (°C)	NA	16.43	16.71	NS	NS	NS	NS	NS	14.00	13.28	13.81	13.46
Dissolved Oxygen (DO; mg/L)	NA	0.19	0.04	NS	NS	NS	NS	NS	0.75	0.15	0.54	0.66
Redox Potential (ORP; mV)	NA	53.6	-24.5	NS	NS	NS	NS	NS	42.1	9.8	92.5	14.0
Conductivity (µS/cm)	NA	330	271	NS	NS	NS	NS	NS	199	220	237	436
Depth to Water (ft-btoc)	NA	7.08	7.26	NS	NS	NS	NS	NS	7.62	7.91	7.87	NS

Table D.14. PMW-5S: Analytical and Field Parameter Results

Sample ID	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S	PMW-5S
Lab Sample No.	8690-8	8698-5	8708-5	8713-12	8717-11		
Sampling Date	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time	161	170	179	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS
tribromomethane	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	NS
tribromochloromethane	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	NS
xlenes (m/p)	NS	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	NS	NS
Ethane	NS	NS	NS	NS	NS	NS	NS
Ethene	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	0.590	0.002	J	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	NS
Chloride	10.5	10.8	10.5	10.8	NS	NS	NS
Nitrite as N	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	71.4 E	71.6 E	66.4 E	68.7 E	NS	NS	NS
Bromide	1.42	1.56	2.71	1.70	1.65	2.80	2.75
Nitrate as N	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS							
pH (SU)	4.21	4.40	4.03	4.89	4.70	4.60	4.62
Temperature (°C)	14.63	14.62	15.45	15.58	15.30	15.85	15.59
Dissolved Oxygen (DO; mg/L)	0.46	4.35	0.65	2.38	2.83	2.63	1.21
Redox Potential (ORP; mV)	111.3	16.2	94.0	16.5	50.6	30.1	33.4
Conductivity (µS/cm)	214	226	208	224	220	220	222
Depth to Water (ft-btoc)	NS	NS	NS	7.94	7.85	7.92	7.86

Table D.15. PMW-5I: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I
Lab Sample No.	POLs and	8533-9	8538-12	8543-7	8546-12	8547-12	8550-14	8551-12	8647-12	8652-3	8665-5	8678-9
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/26/2012	4/3/2012	4/18/2012	5/2/2012
Time		-46	-33	-26	-24	-21	-19	-14	105	113	128	142
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
chloromethane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
vinyl chloride	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
bromomethane	10	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
chloroethane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	8.1 JB	NS	NS	NS	NS	NS	350 U	NS	NS	NS
methylene chloride	3	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1-dichloroethane	50	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
2,2-dichloropropane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
cis-1,2-dichloroethylene	70	208 D	186 D	NS	NS	NS	NS	NS	222 JB	NS	NS	NS
bromochloromethane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
chloroform	70	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
carbon tetrachloride	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1-dichloropropene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
benzene	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2-dichloroethane	2	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
trichloroethylene	1	12500 D	19300 D	NS	NS	NS	NS	NS	16900 D	NS	NS	NS
1,2-dichloropropane	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
tribromomethane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
bromodichloromethane	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
toluene	600	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
tetrachloroethylene	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,3-dichloropropane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
tribromochloromethane	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2-dibromoethane		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
chlorobenzene	50	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
ethylbenzene	700	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
xylene (m/p)	1000	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
o-xylene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
styrene	100	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
bromoform	4	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
bromobenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
n-propyl benzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
2-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
4-chlorotoluene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
tert-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
sec-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
4-isopropyltoluene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
n-butylbenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
hexachlorobutadiene	1	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
naphthalene	300	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
Acetone	6000	100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
carbon disulfide	700	50.0 U	42.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS
2-butanone (MEK)	300	100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
2-hexanone		100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	84.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	186	193	NS	NS	NS	NS	NS	87.9	NS	NS	NS
Ethane	NA	0.44 J	4.0 U	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS
Ethene	NA	0.58 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.145	0.026	NS	NS	NS	NS	NS	0.02	0.0603	0.034	0.0129
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	8630 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	107 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	21.7	22.2	NS	NS	NS	NS	NS	18.3	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	110 E	103 E	NS	NS	NS	NS	NS	70.0 E	NS	NS	NS
Bromide	NA	0.73	0.76	0.78	1.08	1.37	1.50	1.89	1.49	NS	NS	NS
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.51	4.78	NS	NS	NS	NS	NS	5.48	5.57	5.25	5.44
Temperature (°C)	NA	16.24	16.72	NS	NS	NS	NS	NS	14.14	13.73	14.34	13.83
Dissolved Oxygen (DO; mg/L)	NA	0.26	0.31	NS	NS	NS	NS	NS	0.92	0.13	0.68	0.59
Redox Potential (ORP; mV)	NA	39.8	-38.5	NS	NS	NS	NS	NS	-14.9	-34.4	49.1	-78.7
Conductivity (µS/cm)	NA	499	487	NS	NS	NS	NS	NS	370	360	310	501
Depth to Water (ft-btoc)	NA	8.75	9.4	NS	NS	NS	NS	NS	9.15	NS	7.95	NS

Table D.15. PMW-5I: Analytical and Field Parameter Results

Sample ID	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I	PMW-5I
Lab Sample No.	8690-9	8698-6	8708-6	8713-13	8717-12		
Sampling Date	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time	161	170	179	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS
tribromomethane	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	NS
tribromochloromethane	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	NS
xlenes (m/p)	NS	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	NS	NS
Ethane	NS	NS	NS	NS	NS	NS	NS
Ethene	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	0.030	0.009 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	NS
Chloride	17.7	17.7	22.1 E	16.9	NS	NS	NS
Nitrite as N	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	62.4 E	62.7 E	80.1 E	59.4 E	NS	NS	NS
Bromide	1.74	1.91	0.82	2.03	2.04	2.16	2.41
Nitrate as N	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS							
pH (SU)	4.78	4.87	5.25	5.16	5.16	5.15	5.15
Temperature (°C)	14.63	14.85	15.49	15.50	15.40	15.68	15.52
Dissolved Oxygen (DO; mg/L)	0.31	2.03	1.20	2.12	2.67	2.41	1.24
Redox Potential (ORP; mV)	12.6	-35.9	-5.8	-44.9	-46.2	-63.6	-56.5
Conductivity (µS/cm)	238	231	347	244	243	243	243
Depth to Water (ft-btoc)	NS	NS	NS	9.96	9.65	9.85	9.27

Table D.16. PMW-5D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D	PMW-5D
Lab Sample No.	POLs and	8533-10	8538-13	8543-8	8546-13	8547-13	8550-15	8551-13	8649-1	8652-4	8690-10	8698-7
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	4/3/2012	5/21/2012	5/30/2012
Time		-46	-33	-26	-24	-21	-19	-14	106	113	161	170
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloromethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
vinyl chloride	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromomethane	10	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichlorofluoromethane	2000	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethylene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
methylene chloride	3	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethane	50	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2,2-dichloropropane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,2-dichloroethylene	70	11.3	20.5	NS	NS	NS	NS	NS	36.9 D	NS	NS	NS
bromochloromethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroform	70	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1-trichloroethane	30	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
carbon tetrachloride	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloropropene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
benzene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichloroethane	2	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichloroethylene	1	49.1	94.2	NS	NS	NS	NS	NS	1460 D	NS	NS	NS
1,2-dichloropropane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tribromomethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromodichloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
toluene	600	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2-trichloroethane	3	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tetrachloroethylene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichloropropane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tribromochloromethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromoethane		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chlorobenzene	50	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
ethylbenzene	700	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
xylene (m/p)	1000	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
o-xylene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
styrene	100	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromoform	4	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromobenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-propyl benzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-chlorotoluene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-chlorotoluene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3,5-trimethylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tert-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trimethylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
sec-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichlorobenzene	600	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-isopropyltoluene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,4-dichlorobenzene	75	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichlorobenzene	600	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-butylbenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
hexachlorobutadiene	1	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
naphthalene	300	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichlorobenzene		5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Acetone	6000	10.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
carbon disulfide	700	5.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-butanone (MEK)	300	2.0 J	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	6.3	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		10.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-hexanone		10.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-chloroethyl vinyl ether		10.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	372	341	NS	NS	NS	NS	NS	336	NS	NS	NS
Ethane	NA	1.05 J	4.0 U	NS	NS	NS	NS	NS	0.63 J	NS	NS	NS
Ethene	NA	0.46 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.003 J	0.005 J	NS	NS	NS	NS	NS	0.01 U	0.008 U	NS	0.022 U
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	20300 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	110 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	19.5	20.7	NS	NS	NS	NS	NS	15.7	NS	15.1	14.9
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
Sulfate as SO ₄	250	108 E	82.9 E	NS	NS	NS	NS	NS	61.3 D	NS	63.5 E	63.2 E
Bromide	NA	1.14	1.15	1.03	1.13	0.95	0.69	1.21	2.65	NS	2.01	2.19
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.48	4.89	NS	NS	NS	NS	NS	5.72	5.71	5.45	5.54
Temperature (°C)	NA	15.98	15.60	NS	NS	NS	NS	NS	13.70	13.91	14.77	14.91
Dissolved Oxygen (DO; mg/L)	NA	0.18	0.18	NS	NS	NS	NS	NS	1.13	0.14	0.26	0.46
Redox Potential (ORP; mV)	NA	7.7	-55.5	NS	NS	NS	NS	NS	-19.5	-40.2	-47.0	-117.7
Conductivity (µS/cm)	NA	494	375	NS	NS	NS	NS	NS	353	343	352	329
Depth to Water (ft-btoc)	NA	6.91	6.78	NS	NS	NS	NS	NS	8.5	9.2	NS	NS

Table D.16. PMW-5D: Analytical and Field Parameter Results

Sample ID	PMW-5D	PMW-5D	PMW-5D	PMW-5D
Lab Sample No.	8713-14	8717-13		
Sampling Date	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time	182	184	186	190
Matrix	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS
chloroform	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS
benzene	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS
dibromomethane	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS
toluene	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS
dbromochloromethane	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS
xylene (m/p)	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS
styrene	NS	NS	NS	NS
bromoform	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS
Acetone	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS
Ethane	NS	NS	NS	NS
Ethene	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS
Manganese	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS
Chloride	15.0	NS	NS	NS
Nitrite as N	0.2 U	NS	NS	NS
Sulfate as SO ₄	62.6 E	NS	NS	NS
Bromide	2.63	3.05	3.14	2.91
Nitrate as N	0.2 U	NS	NS	NS
O-Phosphate as P	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS
FIELD PARAMETERS				
pH (SU)	5.75	5.78	5.78	5.83
Temperature (°C)	15.83	15.29	15.82	15.37
Dissolved Oxygen (DO; mg/L)	2.27	2.49	2.17	0.96
Redox Potential (ORP; mV)	-83.5	-96.1	-108.7	-114.1
Conductivity (µS/cm)	314	312	319	331
Depth to Water (ft-btoc)	7.91	7.86	7.93	7.94

Table D.17. PMW-6S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S	PMW-6S
Lab Sample No.	POLs and	8533-13	8538-14	8543-9	8546-14	8547-14	8550-16	8551-14	8649-3	8665-6	8690-11	8713-9
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	4/18/2012	5/21/2012	6/11/2012
Time		46	33	26	24	21	19	14	106	128	161	182
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
vinyl chloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromomethane	10	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichlorofluoromethane	2000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethylene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
methylene chloride	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethane	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis 1,2- dichloroethylene	70	36.2 D	36.7	NS	NS	NS	NS	NS	18.3 JD	NS	NS	NS
bromochloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroform	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1-trichloroethane	30	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
carbon tetrachloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloropropene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
benzene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichloroethane	2	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichloroethylene	1	1480 D	2070 D	NS	NS	NS	NS	NS	1160 D	NS	NS	NS
1,2-dichloropropane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
dibromomethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromodichloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
toluene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2-trichloroethane	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tetrachloroethylene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
dibromochloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromoethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chlorobenzene	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
ethylbenzene	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
xylene (m/p)	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
o-xylene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
styrene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromoform	4	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-propyl benzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3,5-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tert-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
sec-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-isopropyltoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,4-dichlorobenzene	75	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
hexachlorobutadiene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
naphthalene	300	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichlorobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Acetone	6000	50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
carbon disulfide	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-butanone (MEK)	300	50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-hexanone		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-chloroethyl vinyl ether		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	21.6	23.6	NS	NS	NS	NS	NS	14.6	NS	NS	NS
Ethane	NA	2.74	2.04	J	NS	NS	NS	NS	0.95	J	NS	NS
Ethene	NA	0.67	5.0	U	NS	NS	NS	NS	5.0	U	NS	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.009	U	0.009	U	NS	NS	NS	0.01	U	0.008	U
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	2680	D	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	63	D	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2	U	0.2	U	NS	NS	NS	NS	NS	NS	NS
Chloride	250	28.3	22.4	NS	NS	NS	NS	NS	7.90	NS	7.95	7.97
Nitrite as N	1	0.2	U	0.2	U	NS	NS	NS	0.2	U	NS	0.2
Sulfate as SO ₄	250	320	E	273	E	NS	NS	NS	75.2	D	NS	58.1
Bromide	NA	0.48	0.49	1.40	2.68	2.91	3.81	5.31	0.38	NS	0.69	1.19
Nitrate as N	10	0.2	U	0.2	U	NS	NS	NS	0.2	U	NS	0.2
O-Phosphate as P	NA	0.2	U	0.2	U	NS	NS	NS	0.2	U	NS	0.2
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.87	5.61	NS	NS	NS	NS	NS	6.35	6.11	6.27	6.48
Temperature (°C)	NA	16.80	16.39	NS	NS	NS	NS	NS	12.91	13.99	14.78	15.24
Dissolved Oxygen (DO; mg/L)	NA	0.53	1.27	NS	NS	NS	NS	NS	0.94	0.56	0.41	2.87
Redox Potential (ORP; mV)	NA	13.0	-99.1	NS	NS	NS	NS	NS	-50.8	-8.4	-64.1	-58.9
Conductivity (µS/cm)	NA	1328	1069	NS	NS	NS	NS	NS	572	534	482	427
Depth to Water (ft-btoc)	NA	9.94	10.52	NS	NS	NS	NS	NS	9.35	9.75	NS	11.69

Table D.17. PMW-6S: Analytical and Field Parameter Results

Sample ID	PMW-6S	PMW-6S	PMW-6S
Lab Sample No.	8717-14		
Sampling Date	6/13/2012	6/15/2012	6/19/2012
Time	184	186	190
Matrix	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS
chloromethane	NS	NS	NS
vinyl chloride	NS	NS	NS
bromomethane	NS	NS	NS
chloroethane	NS	NS	NS
trichlorofluoromethane	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS
methylene chloride	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS
1,1-dichloroethane	NS	NS	NS
2,2-dichloropropane	NS	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS
bromochloromethane	NS	NS	NS
chloroform	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS
carbon tetrachloride	NS	NS	NS
1,1-dichloropropene	NS	NS	NS
benzene	NS	NS	NS
1,2-dichloroethane	NS	NS	NS
trichloroethylene	NS	NS	NS
1,2-dichloropropane	NS	NS	NS
dibromomethane	NS	NS	NS
bromodichloromethane	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS
toluene	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS
tetrachloroethylene	NS	NS	NS
1,3-dichloropropane	NS	NS	NS
dibromochloromethane	NS	NS	NS
1,2-dibromoethane	NS	NS	NS
chlorobenzene	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS
ethylbenzene	NS	NS	NS
xylenes (m/p)	NS	NS	NS
o-xylene	NS	NS	NS
styrene	NS	NS	NS
bromoform	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS
bromobenzene	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS
n-propyl benzene	NS	NS	NS
2-chlorotoluene	NS	NS	NS
4-chlorotoluene	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS
tert-butylbenzene	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS
sec-butylbenzene	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS
4-isopropyltoluene	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS
n-butylbenzene	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS
hexachlorobutadiene	NS	NS	NS
naphthalene	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS
Acetone	NS	NS	NS
carbon disulfide	NS	NS	NS
2-butanone (MEK)	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS
2-hexanone	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L
Methane	NS	NS	NS
Ethane	NS	NS	NS
Ethene	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L
Iron	NS	NS	NS
Manganese	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS
Chloride	NS	NS	NS
Nitrite as N	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS
Bromide	1.37	1.53	1.57
Nitrate as N	NS	NS	NS
O-Phosphate as P	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS
Acetic Acid	NS	NS	NS
Propionic Acid	NS	NS	NS
Formic Acid	NS	NS	NS
Butyric Acid	NS	NS	NS
Pyruvic Acid	NS	NS	NS
Valeric Acid	NS	NS	NS
FIELD PARAMETERS			
pH (SU)	6.48	6.43	6.45
Temperature (°C)	14.93	15.24	15.07
Dissolved Oxygen (DO; mg/L)	3.75	3.27	1.66
Redox Potential (ORP; mV)	-90.7	-109.4	-111.9
Conductivity (µS/cm)	403	387	396
Depth to Water (ft-btoc)	11.50	11.47	10.95

Table D.18. PMW-6I: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I	PMW-6I
Lab Sample No.	PQLs and	8533-14	8538-16	8543-10	8546-15	8547-15	8550-17	8551-15	8649-4	8665-7	8690-12	8713-10
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	4/18/2012	5/21/2012	6/11/2012
Time		-46	-33	-26	-24	-21	-19	-14	106	128	161	182
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
vinyl chloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromomethane	10	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	4.8 J	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
methylene chloride	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	1.7 J	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethane	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2,2-dichloropropane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis 1,2-dichloroethylene	70	121 D	127 NS	NS	NS	NS	NS	NS	85.2 D	NS	NS	NS
bromochloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroform	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
carbon tetrachloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloropropene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
benzene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichloroethane	2	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichloroethylene	1	7910 D	10100 D	NS	NS	NS	NS	NS	6280 D	NS	NS	NS
1,2-dichloropropane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
dibromomethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromodichloromethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
toluene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tetrachloroethylene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichloropropane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
dibromochloromethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromoethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chlorobenzene	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
ethylbenzene	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
xylene (m/p)	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
o-xylene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
styrene	100	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromoform	4	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-propyl benzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tert-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
sec-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-isopropyltoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
hexachlorobutadiene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
naphthalene	300	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Acetone	6000	100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
carbon disulfide	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-butanone (MEK)	300	100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-hexanone		100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	84.2	94.4	NS	NS	NS	NS	NS	77.6	NS	NS	NS
Ethane	NA	0.85 J	4.0 U	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS
Ethene	NA	0.83 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.002 U	0.006 J	NS	NS	NS	NS	NS	0.01 U	0.008 U	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	6330 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	59.7 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	18.6	17.4	NS	NS	NS	NS	NS	10.8	NS	12.3	12.3
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
Sulfate as SO ₄	250	102 E	72.2 E	NS	NS	NS	NS	NS	50.4 D	NS	67.6 E	70.6 E
Bromide	NA	0.55	0.52	5.83	15.3	11.4	9.05	19.8	1.54	NS	1.79	1.60
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	4.71	4.27	NS	NS	NS	NS	NS	4.51	4.08	4.11	4.48
Temperature (°C)	NA	16.60	16.03	NS	NS	NS	NS	NS	13.19	14.08	14.48	15.41
Dissolved Oxygen (DO; mg/L)	NA	0.16	0.34	NS	NS	NS	NS	NS	0.96	0.75	0.22	2.75
Redox Potential (ORP; mV)	NA	77.7	-33.4	NS	NS	NS	NS	NS	71.8	112.3	72.7	8.5
Conductivity (µS/cm)	NA	346	248	NS	NS	NS	NS	NS	174	213	214	219
Depth to Water (ft-btoc)	NA	7.14	7.35	NS	NS	NS	NS	NS	7.60	8.10	NS	8.13

Table D.18. PMW-6I: Analytical and Field Parameter Results

Sample ID	PMW-6I	PMW-6I	PMW-6I
Lab Sample No.	8717-15		
Sampling Date	6/13/2012	6/15/2012	6/19/2012
Time	184	186	190
Matrix	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS
chloromethane	NS	NS	NS
vinyl chloride	NS	NS	NS
bromomethane	NS	NS	NS
chloroethane	NS	NS	NS
trichlorofluoromethane	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS
methylene chloride	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS
1,1-dichloroethane	NS	NS	NS
2,2-dichloropropane	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS
bromochloromethane	NS	NS	NS
chloroform	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS
carbon tetrachloride	NS	NS	NS
1,1-dichloropropene	NS	NS	NS
benzene	NS	NS	NS
1,2-dichloroethane	NS	NS	NS
trichloroethylene	NS	NS	NS
1,2-dichloropropane	NS	NS	NS
dibromomethane	NS	NS	NS
bromodichloromethane	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS
toluene	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS
tetrachloroethylene	NS	NS	NS
1,3-dichloropropane	NS	NS	NS
dibromochloromethane	NS	NS	NS
1,2-dibromoethane	NS	NS	NS
chlorobenzene	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS
ethylbenzene	NS	NS	NS
xylene (m/p)	NS	NS	NS
o-xylene	NS	NS	NS
styrene	NS	NS	NS
bromoform	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS
bromobenzene	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS
n-propyl benzene	NS	NS	NS
2-chlorotoluene	NS	NS	NS
4-chlorotoluene	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS
tert-butylbenzene	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS
sec-butylbenzene	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS
4-isopropyltoluene	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS
n-butylbenzene	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS
hexachlorobutadiene	NS	NS	NS
naphthalene	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS
Acetone	NS	NS	NS
carbon disulfide	NS	NS	NS
2-butanone (MEK)	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS
2-hexanone	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L
Methane	NS	NS	NS
Ethane	NS	NS	NS
Ethene	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L
Iron	NS	NS	NS
Manganese	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS
Chloride	NS	NS	NS
Nitrite as N	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS
Bromide	1.59	2.09	2.92
Nitrate as N	NS	NS	NS
O-Phosphate as P	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS
Acetic Acid	NS	NS	NS
Propionic Acid	NS	NS	NS
Formic Acid	NS	NS	NS
Butyric Acid	NS	NS	NS
Pyruvic Acid	NS	NS	NS
Valeric Acid	NS	NS	NS
FIELD PARAMETERS			
pH (SU)	4.49	4.48	4.60
Temperature (°C)	14.94	15.59	15.36
Dissolved Oxygen (DO; mg/L)	3.20	2.87	1.43
Redox Potential (ORP; mV)	5.8	-14.7	-5.1
Conductivity (µS/cm)	220	221	223
Depth to Water (ft-btoc)	8.01	8.18	8.11

Table D.19. PMW6D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D	PMW-6D
Lab Sample No.	POLs and	8533-16	8538-17	8543-11	8546-16	8547-16	8550-18	8551-16	8649-5	8690-13	8713-11	8717-16
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	5/21/2012	6/11/2012	6/13/2012
Time		-46	-33	-26	-24	-21	-19	-14	106	161	182	184
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
vinyl chloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromomethane	10	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichlorofluoromethane	2000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethylene	1	25.0 U	2.9 J	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
methylene chloride	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloroethane	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,2-dichloroethylene	70	39.8 D	43.8 D	NS	NS	NS	NS	NS	89.9 D	NS	NS	NS
bromochloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chloroform	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1-trichloroethane	30	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
carbon tetrachloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1-dichloropropene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
benzene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichloroethane	2	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trichloroethylene	1	352 D	693 D	NS	NS	NS	NS	NS	1790 D	NS	NS	NS
1,2-dichloropropane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tribromomethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromodichloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
toluene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2-trichloroethane	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tetrachloroethylene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tribromochloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromoethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
chlorobenzene	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
ethylbenzene	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
xylene (m/p)	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
o-xylene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
styrene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromoform	4	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
bromobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-propyl benzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3,5-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
tert-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
sec-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,3-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
4-isopropyltoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,4-dichlorobenzene	75	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
n-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
hexachlorobutadiene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
naphthalene	300	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
1,2,3-trichlorobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
Acetone	6000	50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
carbon disulfide	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	25.0 U	NS	NS	NS
2-butanone (MEK)	300	29.9 J	70.3 J	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-hexanone		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
2-chloroethyl vinyl ether		50.0 U	10.0 U	NS	NS	NS	NS	NS	50.0 U	NS	NS	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	284	278	NS	NS	NS	NS	NS	341	NS	NS	NS
Ethane	NA	1.24 J	0.85 J	NS	NS	NS	NS	NS	0.46 J	NS	NS	NS
Ethene	NA	0.89 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.005 J	0.004 J	NS	NS	NS	NS	NS	0.01 U	NS	NS	NS
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	19200 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	145 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	21.9	26.2	NS	NS	NS	NS	NS	20.8	23.0 E	23.0 E	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS
Sulfate as SO ₄	250	109 E	105 E	NS	NS	NS	NS	NS	103 D	81.0 E	74.5 E	NS
Bromide	NA	0.98	0.97	0.97	1.07	3.08	1.11	1.13	1.90	1.69	1.76	1.41
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	0.2 U	0.2 U	NS
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	4.96	4.76	NS	NS	NS	NS	NS	5.28	4.91	5.23	5.23
Temperature (°C)	NA	15.84	15.50	NS	NS	NS	NS	NS	13.41	14.91	15.67	15.30
Dissolved Oxygen (DO; mg/L)	NA	0.17	0.57	NS	NS	NS	NS	NS	0.99	0.32	2.37	3.01
Redox Potential (ORP; mV)	NA	76.4	-49.1	NS	NS	NS	NS	NS	1.1	17.3	-27.0	-27.3
Conductivity (µS/cm)	NA	442	406	NS	NS	NS	NS	NS	448	322	309	299
Depth to Water (ft-btoc)	NA	9.65	9.89	NS	NS	NS	NS	NS	7.81	NS	9.95	9.68

Table D.19. PMW6D: Analytical and Field Parameter Results

Sample ID	PMW-6D	PMW-6D
Lab Sample No.		
Sampling Date	6/15/2012	6/19/2012
Time	186	190
Matrix	Water	Water
VOCS (GC/MS)	µg/L	µg/L
dichlorodifluoromethane	NS	NS
chloromethane	NS	NS
vinyl chloride	NS	NS
bromomethane	NS	NS
chloroethane	NS	NS
trichlorofluoromethane	NS	NS
1,1-dichloroethylene	NS	NS
methylene chloride	NS	NS
trans-1,2-dichloroethylene	NS	NS
1,1-dichloroethane	NS	NS
2,2-dichloropropane	NS	NS
cis 1,2-dichloroethylene	NS	NS
bromochloromethane	NS	NS
chloroform	NS	NS
1,1,1-trichloroethane	NS	NS
carbon tetrachloride	NS	NS
1,1-dichloropropene	NS	NS
benzene	NS	NS
1,2-dichloroethane	NS	NS
trichloroethylene	NS	NS
1,2-dichloropropane	NS	NS
dibromomethane	NS	NS
bromodichloromethane	NS	NS
cis-1,3-dichloropropene	NS	NS
toluene	NS	NS
trans-1,3-dichloropropene	NS	NS
1,1,2-trichloroethane	NS	NS
tetrachloroethylene	NS	NS
1,3-dichloropropane	NS	NS
tribromochloromethane	NS	NS
1,2-dibromoethane	NS	NS
chlorobenzene	NS	NS
1,1,1,2-tetrachloroethane	NS	NS
ethylbenzene	NS	NS
xylene (m/p)	NS	NS
o-xylene	NS	NS
styrene	NS	NS
bromoform	NS	NS
isopropyl benzene (cumene)	NS	NS
bromobenzene	NS	NS
1,1,2,2-tetrachloroethane	NS	NS
1,2,3-trichloropropane	NS	NS
n-propyl benzene	NS	NS
2-chlorotoluene	NS	NS
4-chlorotoluene	NS	NS
1,3,5-trimethylbenzene	NS	NS
tert-butylbenzene	NS	NS
1,2,4-trimethylbenzene	NS	NS
sec-butylbenzene	NS	NS
1,3-dichlorobenzene	NS	NS
4-isopropyltoluene	NS	NS
1,4-dichlorobenzene	NS	NS
1,2-dichlorobenzene	NS	NS
n-butylbenzene	NS	NS
1,2-dibromo-3-chloropropane	NS	NS
1,2,4-trichlorobenzene	NS	NS
hexachlorobutadiene	NS	NS
naphthalene	NS	NS
1,2,3-trichlorobenzene	NS	NS
Methyl tertiary butyl ether	NS	NS
Acetone	NS	NS
carbon disulfide	NS	NS
2-butanone (MEK)	NS	NS
tetrahydrofuran (THF)	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS
2-hexanone	NS	NS
2-chloroethyl vinyl ether	NS	NS
REDUCED GASES (GC)	µg/L	µg/L
Methane	NS	NS
Ethane	NS	NS
Ethene	NS	NS
OTHER GASES	µg/L	µg/L
Hydrogen	NS	NS
METALS (DISSOLVED)	µg/L	µg/L
Iron	NS	NS
Manganese	NS	NS
ANIONS	mg/L	mg/L
Fluoride	NS	NS
Chloride	NS	NS
Nitrite as N	NS	NS
Sulfate as SO ₄	NS	NS
Bromide	1.79	1.56
Nitrate as N	NS	NS
O-Phosphate as P	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L
Lactic Acid	NS	NS
Acetic Acid	NS	NS
Propionic Acid	NS	NS
Formic Acid	NS	NS
Butyric Acid	NS	NS
Pyruvic Acid	NS	NS
Valeric Acid	NS	NS
FIELD PARAMETERS		
pH (SU)	5.18	5.18
Temperature (°C)	15.82	15.35
Dissolved Oxygen (DO; mg/L)	2.83	1.16
Redox Potential (ORP; mV)	-46.6	-41.8
Conductivity (µS/cm)	294	290
Depth to Water (ft-bloc)	9.60	9.60

Table D.20. PMW-7S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S
Lab Sample No.	PQLs and	8533-11	8538-18	8543-12	8546-17	8547-17	8550-19	8551-17	8556-1	8561-4	8573-3	8576-7	8577-7	8581-7	
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	12/12/2011	12/28/2011	1/5/2012	1/9/2012	1/12/2012	
Time		-46	-33	-26	-24	-21	-19	-14	-6	0	16	24	28	31	
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
cis 1,2- dichloroethylene	70	130 D	142 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trichloroethylene	1	8860 D	10700 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
dibromomethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
dibromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
xylenes (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Methane	NA	115	120	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Hydrogen	NA	0.0045 J	0.0062 J	NS	NS	NS	NS	NS	NS	0.0027 J	0.0080 U	0.0049 J	0.0061 J	0.008	
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron	300	NS	6590 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Manganese	50	NS	73.7 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	NS	2.48	NS	NS	NS	NS	NS	
Dissolved Organic Carbon (DOC)	NA	NS	NS	NS	NS	NS	NS	NS	3.18	NS	NS	NS	NS	NS	
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Chloride	250	17.8	18.8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Sulfate as SO4	250	63.0 E	66.3 E	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Bromide	NA	0.56	0.55	27.4	34.7	8.49	22.3	33.5	NS	NS	NS	NS	NS	NS	
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
FIELD PARAMETERS															
pH (SU)	NA	4.88	4.81	NS	NS	NS	NS	NS	NS	4.67	4.59	4.59	4.57	4.77	
Temperature (°C)	NA	16.67	17.36	NS	NS	NS	NS	NS	NS	15.64	15.01	14.6	14.8	14.38	
Dissolved Oxygen (DO; mg/L)	NA	0.35	1.10	NS	NS	NS	NS	NS	NS	0.33	0.01	0.11	0.11	0.24	
Redox Potential (ORP; mV)															

Table D.20. PMW-7S: Analytical and Field Parameter Results

Sample ID	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S
Lab Sample No.	8653-1	8656-4	8647-17	8652-19	8665-5	8650-2	8656-5	8708-7	8713-6	8717-17	8717-17	8767-4	8767-4
Sampling Date	11/6/2012	2/7/2012	4/3/2012	5/2/2012	5/2/2012	5/2/2012	5/2/2012	6/7/2012	6/11/2012	6/11/2012	6/15/2012	6/19/2012	7/21/2012
Time	15	15	113	13	13	161	170	176	182	184	186	190	231
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
chloromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
vinyl chloride	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
bromomethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
chloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
trichlorofluoromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1-dichloroethylene	NS	NS	4.8 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
methylene chloride	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
trans-1,2-dichloroethylene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1-dichloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
2,2-dichloropropane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
cis-1,2-dichloroethylene	NS	NS	184 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	76.9 D
bromochloromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
chloroform	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1,1-trichloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
carbon tetrachloride	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1-dichloropropene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
benzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2-dichloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
trichloroethylene	NS	NS	9870 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	2880 D
1,2-dichloropropane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
dibromomethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
bromodichloromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
cis-1,3-dichloropropene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
toluene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
trans-1,3-dichloropropene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1,2-trichloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
tetrachloroethylene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,3-dichloropropane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
dibromochloromethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2-dibromoethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
chlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1,1,2-tetrachloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
ethylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
xylene (m/p)	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
o-xylene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
styrene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
bromoform	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
isopropyl benzene (cumene)	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
bromobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,1,2,2-tetrachloroethane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2,3-trichloropropane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
n-propyl benzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
2-chlorotoluene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
4-chlorotoluene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,3,5-trimethylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
tert-butylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2,4-trimethylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
sec-butylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,3-dichlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
n-isopropyltoluene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,4-dichlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2-dichlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
n-butylbenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2-dibromo-3-chloropropane	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2,4-trichlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
hexachlorobutadiene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
naphthalene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
1,2,3-trichlorobenzene	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
Methyl tertiary butyl ether	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
Acetone	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
carbon disulfide	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	105 U
2-butanone (MEK)	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
tetrahydrofuran (THF)	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
4-methyl-2-pentanone (MIBK)	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
2-hexanone	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
2-chloroethyl vinyl ether	NS	NS	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	210 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	76.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	70.2 U
Ethane	NS	NS	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.0 U
Ethene	NS	NS	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Total Hydrogen U	0.008 U	0.008 U	0.084 U	0.008 U	0.008 U	0.008 U	0.057 U	0.009 U	NS	NS	NS	NS	0.009 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U
Chloride	NS	NS	16.6 NS	NS	NS	10.5 NS	10.8 NS	10.9 NS	11.9 NS	NS	NS	NS	10.6 NS
Nitrite as N	NS	NS	0.2 U	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U
Sulfate as SO4	NS	NS	55.9 E	NS	NS	66.6 E	70.8 E	72.8 E	72.8 E	NS	NS	NS	80.8 E
Bromide	NS	NS	1.29 NS	NS	NS	1.89 NS	1.27 NS	1.28 NS	1.40 NS	1.88 NS	3.23 NS	2.44 NS	2.93 NS
Nitrate as N	NS	NS	0.2 U	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U
O-Phosphate as P	NS	NS	0.2 U	NS	NS	0.2 U	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	mg/L	mg/L	mg/L	mg/L
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	4.88	4.51	4.61	4.64	3.99	3.75	3.85	4.11	4.23	4.17	4.24	4.24	4.12
Temperature (°C)	13.31	14.13	13.38	13.88	13.25	15.13	15.95	16.57	16.75	16.68	16.53	16.61	18.58
Dissolved Oxygen (DO; mg/L)	0.93	3.89	0.15	0.61	0.75	0.41	0.73	1.15	0.35	0.17	1.30	0.62	0.12
Redox Potential (ORP; mV)	-30.8	96.1	44.9	-65.4	172.6	148.2	-7.3	122.5	147.8	150.5	121.2	117.1	-75.1
Conductivity (µS/cm)	206	176	237	195	225	224	233	223	229	229	230	230	213
Depth to Water (ft-btcc)	6.05	6.15	6.60	6.90	6.95	NS	NS	NS	7.10	6.76	6.95	6.85	NS
gPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.20. PMW-7S: Analytical and Field Parameter Results

Sample ID	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	
Lab Sample No.	8807-2	8818-2	8818-2	8837-1	8839-5	8840-5	8850-5	8852-5	8869-5	8876-5	8883-1	8896-2	8905-2	
Sampling Date	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	12/18/2012	1/17/2013	2/7/2013	
Time	248	262	275	294	295	296	298	316	339	358	372	402	423	
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	
VOCs (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
chloromethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
vinyl chloride	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
bromomethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
chloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	1.8	J	
methylene chloride	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	0.6	J	
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
cis 1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	73.1	D	NS	NS	84.7	D	
bromochloromethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
chloroform	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
benzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
trichloroethylene	NS	NS	NS	NS	NS	NS	NS	2990	D	NS	NS	3060	D	
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
ethylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
xylene (m/p)	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
o-xylene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
styrene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
bromoforn	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
bromobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
naphthalene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
Acetone	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
carbon disulfide	NS	NS	NS	NS	NS	NS	NS	42.0	U	NS	NS	5.0	U	
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
2-hexanone	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS	84.0	U	NS	NS	10.0	U	
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Methane	NS	NS	NS	NS	NS	NS	NS	231	NS	NS	NS	258	200	
Ethane	NS	NS	NS	NS	NS	NS	NS	2.0	J	NS	NS	3.02	J	
Ethene	NS	NS	NS	NS	NS	NS	NS	4.5	J	NS	NS	10.4	5.58	
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Hydrogen	0.009	U	0.009	U	0.009	U	0.0077	J	0.0042	J	0.009	U	0.0034	J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron	NS	NS	NS	NS	NS	NS	NS	6930	D	NS	NS	6440	D	
Manganese	NS	NS	NS	NS	NS	NS	NS	55.7	D	NS	NS	63.3	D	
Arsenic	NS	NS	NS	NS	NS	NS	NS	2.5	U	NS	NS	NS	NS	
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6400	D	
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	63.1	D	
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.26	J	
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Fluoride	NS	0.14	J	0.14	J	1.0	U	1.0	U	0.15	J	NS	0.29	
Chloride	NS	24.2	23.0	30.7	19.1	9.77	15.9	16.8	NS	19.5	19.7	20.1	16.7	
Nitrite as N	NS	0.2	U	0.2	U	1.0	U	1.0	U	0.2	U	0.2	U	
Sulfate as SO4	NS	76.6	E	66.5	E	109	D	87.8	D	28.3	D	56.7	D	
Bromide	NS	1.22	1.26	0.55	J	377	42.1	103	10.10	NS	47.0	E	48.5	
Nitrate as N	NS	0.2	U	0.2	U	1.0	U	1.0	U	1.0	U	0.2	U	
Orthophosphate as P	NS	0.2	U	0.2	U	1.0	U	1.0	U	0.2	U	0.2	U	
VOLATILE FATTY ACIDS	mg/L	0.009	U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Acetic Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Acetic Acid	NS	NS	0.24	J	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Propionic Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Formic Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Butyric Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Pyruvic Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
Valeric Acid	NS	NS	1.0	U	NS	NS	NS	NS	NS	NS	NS	1.0	U	
FIELD PARAMETERS														
pH (SU)	4.24	4.35	4.88	4.53	4.50		4.86	4.94	5.09	5.00	4.77	5.10	5.17	
Temperature (°C)	18.09	17.96	18.32	18.07	18.07	17.79	18.14	17.08	13.62	16.24	15.82	14.25	12.24	
Dissolved Oxygen (DO: mg/L)	0.30	0.50	3.46	0.74	7.79	0.13	0.19	0.26	0.56	0.33	0.52	0.40	0.78	
Redox Potential (ORP: mV)	-53.4	-58.1	34.1	62.9	68.4	42.4	25.4	-52.8	25	-106.1	43.0	-48.7	-127.8	
Conductivity (µS/cm)	264	266	257	288	734	232	322	225	157	240	220	213	230	
Depth to Water (ft-btoc)	7.30	7.48	7.29	7.48	7.48	7.80	7.38	7.61	7.04	7.41	7.26	NS	8.05	
PCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	
DHC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.49E+05	NS	

Table D.20. PMW-7S: Analytical and Field Parameter Results

Sample ID	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S	PMW-7S
Lab Sample No.	8929-2	8954-6	8977-6	8993-1	9017-1	9040-2	9051-1
Sampling Date	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013	11/12/2013	12/18/2013
Time	458	499	547	568	645	701	737
Matrix	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
vinyl chloride	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	1.27 J
bromomethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trichlorofluoromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloroethylene	25.0 U	2.8 J	NS	3.7 J	3.8 J	4.0 J	5.27 J
methylene chloride	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	25.0 U	21.0 U	NS	42.0 U	1.1 J	1.59 J	3.02 J
1,1-dichloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2,2-dichloropropane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
cis 1,2-dichloroethylene	60.1 D	106 D	NS	186 D	209	267	637
bromochloromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloroform	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
carbon tetrachloride	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloropropene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
benzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dichloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trichloroethylene	2420 D	4240 D	NS	4880 D	2440 D	2430 D	6110 D
1,2-dichloropropane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromodichloromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
toluene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trans-1,3-dichloropropene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
tetrachloroethylene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3-dichloropropane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromochloromethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromoethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
ethylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
xylene (m/p)	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
o-xylene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
styrene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromoform	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
n-propyl benzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2-chlorotoluene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
4-chlorotoluene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
tert-butylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
sec-butylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
4-isopropyltoluene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
n-butylbenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
hexachlorobutadiene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
naphthalene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
Acetone	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
carbon disulfide	25.0 U	21.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2-butanone (MEK)	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
2-hexanone	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether	50.0 U	42.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	88.3	55.7	NS	40.0	64.3	30.1	242
Ethane	4.0 U	4.0 U	NS	4.0 U	2.0 U	2.0 U	2.0 U
Ethene	2.55 J	5.0 U	NS	5.0 U	3.74	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.008 U	0.008 U	0.0036 J	0.0012 J	0.0038 J	0.0151	0.0025 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	6350 D	NS	NS	NS
Manganese	NS	NS	NS	94.0 D	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	2.59	1.40 J	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Chloride	17.5	23.4 D	NS	21.4	15.8	11.8	25.0 D
Nitrite as N	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate as SO4	40.3 E	65.5 E	NS	53.1 E	51.9 D	43.7 D	56.1 D
Bromide	3.66	0.64	NS	1.57	1.90	1.4	1.54
Nitrate as N	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	0.2 U	NS	2.80	0.2 U	0.30	0.32
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Acetic Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Propionic Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Formic Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Butyric Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Pyruvic Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
Valeric Acid	1.0 U	1.0 U	NS	NS	NS	NS	NS
FIELD PARAMETERS							
pH (SU)	5.03	4.74	5.06	5.04	5.24	5.72	5.31
Temperature (°C)	12.38	13.05	14.50	15.00	16.71	15.61	14.67
Dissolved Oxygen (DO; mg/L)	0.13	0.31	0.19	0.29	0.14	0.16	1.45
Redox Potential (ORP; mV)	15.2	73.9	60.2	40.6	-51.5	-63.6	45.0
Conductivity (µS/cm)	193	247	154	256	213	276	378
Depth to Water (ft-bloc)	NR	NR	NR	6.01	7.01	7.60	7.21
qPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	3.20E+01 U	NS	NS	NS	NS	NS	NS

Table D.21. PMW-7I: Analytical and Field Parameter Results

Sample ID	NJ Higher of POLs and Sampling Date	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71
Lab Sample No.		8533-12	8538-19	8543-13	8546-18	8547-18	8550-20	8551-18	8556-3				
Sampling Date	GW Quality	10/26/2011	11/9/2011	11/16/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	12/12/2011	12/28/2011	1/5/2012	1/9/2012
Time		46	-33	-26	-24	-21	-19	-14	-6	12	16	24	28
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	141 D	127 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	1	7090 D	8940 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	14.1 J	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	149	151	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethane	NA	0.48 J	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004 J	0.009 U	NS	NS	NS	NS	NS	NS	NS	0.0080 U	0.0044 J	0.0040
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	6630 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	66.8 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	NS	4.61	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NA	NS	NS	NS	NS	NS	NS	NS	4.62	NS	NS	NS	NS
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	20.2	19.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate as SO4	250	83.2 E	75.1 E	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bromide	NA	0.66	0.64	1.39	8.00	13.5	7.65	12.7	NS	NS	NS	NS	NS
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	NA	5.85	5.80	NS	NS	NS	NS	NS	NS	5.99	5.95	5.88	5.86
Temperature (°C)	NA	16.63	17.42	NS	NS	NS	NS	NS	NS	14.97	13.99	14.5	14.9
Dissolved Oxygen (DO, mg/L)	NA	0.43	2.47	NS	NS	NS	NS	NS	NS	0.62	0.10	0.15	0.14
Redox Potential (ORP, mV)	NA	-32.4	-71.4	NS	NS	NS	NS	NS	NS	-87.6	-43.5	-22.8	34.3
Conductivity (µS/cm)	NA	505	412	NS	NS	NS	NS	NS	NS	798	393	409.0	394.8
Depth to Water (ft-btoc)	NA	10.8	14.35	NS	NS	NS	NS	NS	NS	12.05	8.85	5.90	8.11
gPCR		cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.21. PMW-7I: Analytical and Field Parameter Results

Sample ID	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71	PMW-71
Lab Sample No.	8581-8	8583-2	8596-5	8647-18	8652-16	8665-9	8690-3	8698-9	8708-8	8713-3	8717-18	6/15/2012	6/19/2012
Sampling Date	1/12/2012	1/16/2012	2/7/2012	3/26/2012	4/3/2012	4/18/2012	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time	31	35	57	105	113	128	161	170	178	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	7.5 JD	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	184 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	8750 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
dlbromomethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
dlbromochloromethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	25.0 U	NS								

Table D.21. PMW-7I: Analytical and Field Parameter Results

Sample ID	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	
Lab Sample No.	8767-5	8767-5	8807-3	8818-3	8837-2	8839-6	8840-7	8850-7	8852-7	8869-7	8876-6	8883-2	8896-3
Sampling Date	7/30/2012	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	12/18/2012	1/17/2013
Time	231	248	262	275	294	295	296	298	316	339	358	372	402
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
vinyl chloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromomethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trichlorofluoromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	4.9 J	NS	NS	3.9 J	5.0 U
methylene chloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trans-1,2-dichloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2,2-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
cis-1,2-dichloroethylene	117 D	NS	NS	NS	NS	NS	NS	NS	118 D	NS	NS	112	137
bromochloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloroform	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,1-trichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
carbon tetrachloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
benzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trichloroethylene	5490 D	NS	NS	NS	NS	NS	NS	NS	5240 D	NS	NS	4940 D	4190 D
1,2-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
dibromomethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromodichloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
cis-1,3-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
toluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trans-1,3-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,2-trichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
tetrachloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
dibromochloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dibromoethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
ethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
xlenes (m/p)	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
o-xylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
styrene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromoform	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
isopropyl benzene (cumene)	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,3-trichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
n-propyl benzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2-chlorotoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
4-chlorotoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3,5-trimethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
tert-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,4-trimethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
sec-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
4-isopropyltoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,4-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
n-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,4-trichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
hexachlorobutadiene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
naphthalene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,3-trichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
Methyl tertiary butyl ether	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
Acetone	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
carbon disulfide	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2-butanone (MEK)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
tetrahydrofuran (THF)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
2-hexanone	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
2-chloroethyl vinyl ether	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	88.2	NS	NS	NS	NS	NS	NS	NS	188	NS	NS	241	200
Ethane	4.0 U	NS	NS	NS	NS	NS	NS	NS	1.9 J	NS	NS	2.98 J	2.47 J
Ethene	5.0 U	NS	NS	NS	NS	NS	NS	NS	4.3 J	NS	NS	8.33	6.89
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.009 U	0.009 U	0.0054 J	0.0021 J	0.009 U	0.0051 J	0.0036 J	0.009 U	0.009 U	0.0026 J	0.009 U	0.0040 J	0.03 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	4140 D	NS	NS	5430 D	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	168 D	NS	NS	176 D	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	2.5 U	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	5400 D	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	179 D	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.55 J
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	36.4	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	NS	0.10 J	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.12 J	0.2 U	0.2 U
Chloride	9.8	NS	17.4	7.61	20.6	21.6	17.8	16.6	15.2	NS	15.9	19.7	20.7
Nitrite as N	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
Sulfate as SO4	60.7 E	NS	62.3 E	40.9	63.2 D	52.9 D	49.6 D	50.5 D	41.3 E	NS	36.2 E	41.8 E	48.6 E
Bromide	7.83	NS	5.05	35.4	1.89	9.04	162	32.3	NS	NS	14.1	9.61	5.81
Nitrate as N	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	0.0054 J	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	0.2 U	mg/L
Lactic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Acetic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Propionic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Formic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Butyric Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Pyruvic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Valeric Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
FIELD PARAMETERS													
pH (SU)	5.32	5.66	5.69	5.89	5.55	5.42	5.45	5.40	5.70	5.47	5.30	5.48	5.65
Temperature (°C)	18.32	18.14	17.92	17.45	17.88	17.64	17.64	17.74	16.88	13.63	16.35	15.90	14.37
Dissolved Oxygen (DO; mg/L)	0.20	0.22	0.65	3.49	0.66	0.37	0.20	0.28	0.12	0.21	0.24	0.48	0.36
Redox Potential (ORP; mV)	-156.5	-152.8	-128.4	-47.1									

Table D.21. PMW-7I: Analytical and Field Parameter Results

Sample ID	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I	PMW-7I
Lab Sample No.	8905-3	8929-3	8954-7	8977-7	8993-2	9017-2	9040-3	9051-2
Sampling Date	2/7/2013	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013	11/12/2013	12/18/2013
Time	423	458	499	547	568	645	701	737
Matrix	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
vinyl chloride	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	3.69 J	1.48 J
bromomethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloroethane	2.6 J	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trichlorofluoromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloroethylene	25.0 U	25.0 U	4.3 JD	NS	3.5 JD	7.8	5.66	5.72
methylene chloride	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	25.0 U	25.0 U	25.0 U	NS	42.0 U	3.0 J	2.16 J	2.95 J
1,1-dichloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2,2-dichloropropane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-dichloroethylene	89.4	95.2 D	120 D	NS	234 D	764 D	430	604
bromochloromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chloroform	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
carbon tetrachloride	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloropropene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
benzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dichloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trichloroethylene	4010 D	4320 D	5440 D	NS	4070 D	2270 D	2470	3540
1,2-dichloropropane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
dibromomethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromodichloromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
toluene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
trans-1,3-dichloropropene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
tetrachloroethylene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3-dichloropropane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
dibromochloromethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromoethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
chlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
ethylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
xlenes (m/p)	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
o-xylene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
styrene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromoform	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
bromobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
n-propyl benzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2-chlorotoluene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
4-chlorotoluene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
tert-butylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
sec-butylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
4-isopropyltoluene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
n-butylbenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
hexachlorobutadiene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
naphthalene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
Acetone	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
carbon disulfide	25.0 U	25.0 U	25.0 U	NS	42.0 U	5.0 U	5.0 U	5.0 U
2-butanone (MEK)	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
2-hexanone	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether	50.0 U	50.0 U	50.0 U	NS	84.0 U	10.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	67.7	70.7	60.4	NS	37.2	54.2	31.8	191
Ethane	4.0 U	1.04 J	4.0 U	NS	4.0 U	2.0 U	2.0 U	2.0 U
Ethene	3.29 J	2.97 J	5.0 U	NS	5.0 U	2.35 J	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0039 J	0.0063 J	0.008 U	0.0362	0.0063 J	0.0035 J	0.0024 J	0.0013 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	3410 D	NS	NS	NS
Manganese	NS	NS	NS	NS	81.2 D	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	2.23	2.99	1.94 J	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Chloride	16.6	16.6	19.8	NS	14.5	11.1	15.0	18.2
Nitrite as N	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate as SO4	38.2 E	35.1 E	54.3 E	NS	35.2 E	32.9 D	41.0 D	33.2 D
Bromide	3.32	3.26	0.94	NS	0.96	1.43	1.89	1.42
Nitrate as N	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	0.2 U	0.2 U	NS	0.49	0.2 U	0.41	0.22
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Acetic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Propionic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Formic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Butyric Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Pyruvic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Valeric Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
FIELD PARAMETERS								
pH (SU)	5.56	5.47	5.72	5.33	5.47	5.83	5.49	5.78
Temperature (°C)	12.85	12.94	13.65	14.34	15.14	16.89	15.33	14.46
Dissolved Oxygen (DO; mg/L)	0.68	0.17	0.31	0.08	0.24	0.12	0.16	0.88
Redox Potential (ORP; mV)	-133.0	-6.5	-2.2	7.1	11.2	-48.6	-136.7	-34.0
Conductivity (µS/cm)	254	214	269	169	199	202	201	198
Depth to Water (ft-btoc)	9.83	NR	NR	NR	8.09	7.81	8.60	8.06
qPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NS	3.20E+01 U	NS	NS	NS	NS	NS	NS

Table D.22. PMW-7D: Analytical and Field Parameter Results

Sample ID	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D
Lab Sample No.	8767-6		8807-4	8818-4	8837-3	8839-7	8840-6	8850-6	8852-8	8869-6	8876-7	8883-3	8896-4
Sampling Date	7/30/2012	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	12/18/2012	1/17/2013
Time	231	248	262	275	294	295	296	298	316	339	358	372	402
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
vinyl chloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromomethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	0.8 J	5.0 U
trichlorofluoromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	2.4 J	5.0 U
methylene chloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trans-1,2-dichloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2,2-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
cis 1,2- dichloroethylene	34.7 JD	NS	NS	NS	NS	NS	NS	NS	66.9 D	NS	NS	90.2 J	74.9 J
bromochloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chloroform	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,1-trichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
carbon tetrachloride	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
benzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trichloroethylene	1500 D	NS	NS	NS	NS	NS	NS	NS	1230 D	NS	NS	1100 J	564 J
1,2-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
dibromomethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromodichloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
cis-1,3-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
toluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
trans-1,3-dichloropropene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,2-trichloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
tetrachloroethylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3-dichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
dibromochloromethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dibromoethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
chlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
ethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
xlenes (m/p)	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
o-xylene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
styrene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromoform	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
isopropyl benzene (cumene)	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
bromobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,3-trichloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
n-propyl benzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2-chlorotoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
4-chlorotoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3,5-trimethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
tert-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,4-trimethylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
sec-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,3-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
4-isopropyltoluene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,4-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
n-butylbenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,4-trichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
hexachlorobutadiene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
naphthalene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
1,2,3-trichlorobenzene	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
Methyl tertiary butyl ether	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
Acetone	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
carbon disulfide	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS	NS	5.0 U	5.0 U
2-butanone (MEK)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
tetrahydrofuran (THF)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
2-hexanone	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
2-chloroethyl vinyl ether	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS	NS	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	163	NS	NS	NS	NS	NS	NS	NS	231	NS	NS	259	87.8
Ethane	4.0 U	NS	NS	NS	NS	NS	NS	NS	5.2	NS	NS	10.4	3.13 J
Ethene	5.0 U	NS	NS	NS	NS	NS	NS	NS	22.9	NS	NS	62.2	13.9
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.009 U	0.009 U	0.009 U	0.0066 J	0.009 U	0.0041 J	0.009 U	0.009 U	0.0034 J	0.0046 J	0.0046 J	0.0038 J	0.03 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	8010 D	NS	NS	8080 D	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	113 D	NS	NS	118 D	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	2.5 U	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7230 D	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	103 D	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.88 J
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	66.3	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
Chloride	8.85	NS	10.1	5.44	9.24	8.98	12.8	10.5	8.49	NS	15.4	16.1	7.77
Nitrite as N	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
Sulfate as SO4	56.1 E	NS	45.1	22.5	37.5	27.1	24.6	33.0	13.7	NS	26.9 E	18.6	14.5
Bromide	121	NS	38.6	1.31	21.4	50.4	4.21	109	114	NS	13.5	7.83	3.30
Nitrate as N	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Acetic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Propionic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Formic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Butyric Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Pyruvic Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
Valeric Acid	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	1.0 U
FIELD PARAMETERS													
pH (SU)	5.53	5.73	5.95	5.98	5.84	5.80	5.80	5.63	6.10	5.89	5.80	5.82	6.04
Temperature (°C)	17.67	17.82	17.12	17.95	17.40	17.48	17.21	17.32	16.50	13.42	16.49	16.22	14.48
Dissolved Oxygen (DO; mg/L)	0.14	0.21	0.41	3.46	0.55	0.35	0.16	0.25	0.08	0.34	0.33	0.46	0.21
Redox Potential (ORP; mV)	-144.3	-132.6	-19.0	-23.7	12.5	49.2							

Table D.22. PMW-7D: Analytical and Field Parameter Results

Sample ID	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D	PMW-7D
Lab Sample No.	8905-4	8929-4	8954-8	8977-8	8993-3	9017-3	9040-4	9051-3
Sampling Date	2/7/2013	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013	11/12/2013	12/18/2013
Time	423	458	499	547	568	645	701	737
Matrix	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chloromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
vinyl chloride	25.0 U	1.8 J	25.0 U	NS	5.0 U	5.0 U	6.62 J	2.68 J
bromomethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trichlorofluoromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloroethylene	25.0 U	2.5 J	3.0 JD	NS	2.2 J	5.5 J	4.24 J	2.02 J
methylene chloride	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	25.0 U	5.0 U	25.0 U	NS	5.0 U	3.5 J	2.64 J	2.61 J
1,1-dichloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2,2-dichloropropane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
cis 1,2- dichloroethylene	93.0	119	129 D	NS	322	537	483	248
bromochloromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
chloroform	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
1,1,1-trichloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
carbon tetrachloride	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
1,1-dichloropropene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
benzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
1,2-dichloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5 U
trichloroethylene	927	1020	1280 D	NS	566	623	751	394
1,2-dichloropropane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
dibromomethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromodichloromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
toluene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trans-1,3-dichloropropene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
tetrachloroethylene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3-dichloropropane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
dibromochloromethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromoethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
ethylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
xlenes (m/p)	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
o-xylene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
styrene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromoform	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
n-propyl benzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2-chlorotoluene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
4-chlorotoluene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
tert-butylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
sec-butylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
4-isopropyltoluene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
n-butylbenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
hexachlorobutadiene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
naphthalene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
carbon disulfide	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2-butanone (MEK)	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
2-hexanone	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	66.6	81.3	56.0	NS	29.2	88.8	38.2	63.7
Ethane	2.37 J	2.70 J	4.0 U	NS	4.0 U	2.0 U	2.0 U	2.0 U
Ethene	13.7	11.8	5.90	NS	2.21 J	3.20	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0016 J	0.008 U	0.008 U	0.0590 J	0.008 U	0.0040 J	0.0079 J	0.008 U
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	4790 D	NS	NS	NS
Manganese	NS	NS	NS	NS	67.1 D	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	1.62 J	1.88 J	1.00 J	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Chloride	15.7	15.2	13.8	NS	9.09	9.33	12.6	6.94
Nitrite as N	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate as SO4	20.9	19.9	21.6	NS	20.6	14.8	33.1 D	16.2
Bromide	3.57	3.27	2.06	NS	1.51	1.18	1.53	0.74
Nitrate as N	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	0.2 U	0.2 U	NS	0.19	0.2 U	0.2 U	0.20
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Acetic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Propionic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Formic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Butyric Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Pyruvic Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Valeric Acid	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
FIELD PARAMETERS								
pH (SU)	5.96	5.90	5.99	5.79	5.87	5.97	5.83	6.14
Temperature (°C)	13.35	13.52	14.23	14.69	15.48	16.88	14.92	14.50
Dissolved Oxygen (DO; mg/L)	0.67	0.17	0.45	0.22	0.25	0.13	0.11	0.33
Redox Potential (ORP; mV)	-138.3	-36.1	-31.5	17.9	-20.0	-55.5	-183.2	-32.9
Conductivity (µS/cm)	296	242	271	212	189	197	221	264
Depth to Water (ft-btoc)	7.38	NR	NR	NR	6.30	7.15	7.83	7.56
qPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NS	3.20E+01 U	NS	NS	NS	NS	NS	NS

Table D.23. PMW-8S: Analytical and Field Parameter Results

Sample ID	NJ Higher of Lab Sample No. Sampling Date Time Matrix	PMW-8S 8533-17 10/26/2011 -46 Water	PMW-8S 8539-1 11/9/2011 -33 Water	PMW-8S 8546-20 11/18/2011 -24 Water	PMW-8S 8547-20 11/21/2011 -21 Water	PMW-8S 8550-22 11/23/2011 -19 Water	PMW-8S 8551-20 11/28/2011 -14 Water	PMW-8S 8556-2 12/6/2011 -6 Water	PMW-8S 8561-6 12/12/2011 0 Water	PMW-8S 8563-4 1/16/2012 35 Water	PMW-8S 8596-7 2/17/2012 57 Water	PMW-8S 8647-19 3/27/2012 106 Water	PMW-8S 8652-12 4/3/2012 113 Water
VOCs (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
vinyl chloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromomethane	10	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloroethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trichlorofluoromethane	2000	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethylene	1	50.0 U	2.8 J	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
methylene chloride	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trans-1,2-dichloroethylene	100	50.0 U	1.6 J	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloroethane	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2,2-dichloropropane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
cis-1,2-dichloroethylene	70	117 D	75.5 NS	NS	NS	NS	NS	NS	NS	NS	NS	225 D	NS
bromochloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chloroform	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,1-trichloroethane	30	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
carbon tetrachloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1-dichloropropene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
benzene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dichloroethane	2	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trichloroethylene	1	5610 D	4380 D	NS	NS	NS	NS	NS	NS	NS	NS	5520 D	NS
1,2-dichloropropane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
dibromomethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromodichloromethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
cis-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
toluene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
trans-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,2-trichloroethane	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
tetrachloroethylene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3-dichloroethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
dibromochloromethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dibromoethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
chlorobenzene	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,1,2-tetrachloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
ethylbenzene	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
xlenes (m/p)	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
o-xylene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
styrene	100	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromofom	4	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
isopropyl benzene (cumene)	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
bromobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,1,2,2-tetrachloroethane	1	50.0 U	5.2 NS	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,3-trichloropropane	0.03	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
n-propyl benzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
4-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3,5-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
tert-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,4-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
sec-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,3-dichlorobenzene	600	50.0 U	1.5 J	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
4-isopropyltoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,4-dichlorobenzene	75	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dichlorobenzene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
n-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,4-trichlorobenzene	9	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
hexachlorobutadiene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
naphthalene	300	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
1,2,3-trichlorobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
Methyl tertiary butyl ether	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
Acetone	6000	100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
carbon disulfide	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	25.0 U	NS
2-butanone (MEK)	300	100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
tetrahydrofuran (THF)	10	100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
4-methyl-2-pentanone (MIBK)		100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
2-hexanone		100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
2-chloroethyl vinyl ether		100.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	50.0 U	NS
REDUCED GASES (GC)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	NS	95.3 J	60.0 U	NS	NS	NS	NS	NS	NS	NS	49.8 NS	NS
Ethane	NA	NS	0.44 J	4.0 U	NS	NS	NS	NS	NS	NS	NS	4.0 U	NS
Ether	NA	NS	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS
OTHER GASES		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.006 J	0.002 J	NS	NS	NS	NS	NS	0.0043 NS	0.008 U	0.008 U	0.102 NS	0.008 U
METALS (DISSOLVED)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	NS	1670	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	NS	52.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	8.19 NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NA	NS	NS	NS	NS	NS	NS	8.84 NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	16.5 NS	10.2 NS	NS	NS	NS	NS	NS	NS	NS	NS	12.6 NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
Sulfate as SO4	250	90.1 E	35.4 E	NS	NS	NS	NS	NS	NS	NS	NS	39.6 E	NS
Bromide	NA	0.51 NS	0.44 NS	10.6 NS	9.00 NS	0.75 NS	8.69 NS	NS	NS	NS	NS	1.78 NS	NS
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS
VOLATILE FATTY ACIDS		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	NA	5.72 NS	6.26 NS	NS	NS	NS	NS	NS	6.27 NS	6.37 NS	6.14 NS	5.98 NS	6.01 NS
Temperature (°C)	NA	16.58 NS	16.06 NS	NS	NS	NS	NS	NS	15.06 NS	14.31 NS	13.71 NS	13.61 NS	13.88 NS
Dissolved Oxygen (DO: mg/L)	NA	0.32 NS	5.77 NS	NS	NS	NS	NS	NS	0.13 NS	0.35 NS	2.01 NS	0.07 NS	0.58 NS
Redox Potential (ORP: mV)	NA	-67.2 NS	15.1 NS	NS	NS	NS	NS	NS	-29.7 NS	-106.1 NS	5.0 NS	-77.5 NS	-138.5 NS
Conductivity (µS/cm)	NA	441 NS	232 NS	NS	NS	NS	NS	NS	133 NS	285 NS	316 NS	366 NS	301 NS
Depth to Water (ft-bloc)	NA	8.53 NS	7.50 NS	NS	NS	NS	NS	NS	6.70 NS	6.29 NS	6.32 NS	6.71 NS	7.05 NS
qPCR													
BHC	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.23. PMW-8S: Analytical and Field Parameter Results

Sample ID	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S
Lab Sample No.	8698-11	8708-10	8713-21	8717-20	6/15/2012	6/19/2012	8767-7	8/16/2012	8807-5	8818-5	8837-8	8839-8	8840-8
Sampling Date	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012	7/30/2012	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012
Time	170	178	182	184	186	190	231	248	262	275	294	295	296
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	148 D	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	2090 D	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
dibromomethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
dibromochloromethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
xylene (m/p)	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
4-dichlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
1,2,3 trichlorobenzene	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
Carbon disulfide	NS	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	NS	149	NS	NS	NS	NS	NS	NS
Ethane	NS	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS	NS
Ethene	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0086 U	0.009 U	NS	NS	NS	NS	0.009 U	NS	0.009 U	0.0165	0.0051 J	0.0045 J	0.0035 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	0.2 U	NS	0.11 J	0.12 J	1.0 U	1.0 U	1.0 U
Chloride	10.0	10.3	11.5	NS	NS	NS	14.2	NS	20.0	7.07	10.1	10.0	10.2
Nitrite as N	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U
Sulfate as SO4	47.9 E	52.4 E	59.0 E	NS	NS	NS	65.2 E	NS	67.4 D	15.7 D	18.8 D	24.3 D	26.8 D
Bromide	3.39	2.46	2.30	2.11	2.66	2.83	2.11	NS	1.56	0.44	1.0 U	0.58 J	82.5
Nitrate as N	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U
O-Phosphate as P	0.2 U	0.2 U	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.79 J	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	5.90	5.93	6.01	5.93	5.87	5.91	5.64	5.82	5.89	6.17	5.95	5.92	5.78
Temperature (°C)	15.38	16.08	16.42	16.01	16.27	16.14	17.50	17.73	17.57	18.01	18.11	17.94	18.07
Dissolved Oxygen (DO; mg/L)	0.45	0.82	5.42	0.01	0.89	0.18	0.08	0.16	0.37	3.45	0.74	0.23	0.17
Redox Potential (ORP; mV)	-89.1	-35.2	-22.8	-38.7	-16.9	-45.1	-181.9	-169.4	-112.1	-72.0	25.5	26.7	37.1
Conductivity (µS/cm)	311	337	333	326	315	317	367	397	380	185	229	224	265
Depth to Water (ft-bloc)	NS	NS	7.36	7.04	7.21	7.50	NS	7.44	-7.60	7.50	7.90	7.99	7.6
gPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.23. PMW-8S: Analytical and Field Parameter Results

Sample ID	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S	PMW-8S
Lab Sample No.	8850-8	8852-9	8869-8	8876-8	8883-4	8896-5	8905-5	8929-5	8954-9	8977-9	8993-4	9017-4
Sampling Date	10/5/2012	10/23/2012	11/15/2012	12/4/2012	12/18/2012	1/17/2013	2/7/2013	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013
Time	298	316	339	358	372	402	423	458	499	547	568	645
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
chloromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
vinyl chloride	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
bromomethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
chloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
trichlorofluoromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1-dichloroethylene	NS	42.0 U	NS	NS	2.1 J	5.0 U	25.0 U	1.8 J	25.0 U	NS	1.1 J	7.2 J
methylene chloride	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
trans-1,2-dichloroethylene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	2.5 J
1,1-dichloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
2,2-dichloropropane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
cis-1,2-dichloroethylene	NS	153 D	NS	NS	102 J	28.1 J	51.3 D	58.8 J	72.1 D	NS	137 J	264 J
bromochloromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
chloroform	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1,1-trichloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
carbon tetrachloride	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1-dichloropropene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
benzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2-dichloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
trichloroethylene	NS	1240 D	NS	NS	1450 D	306 J	740 D	843 J	1410 D	NS	674 J	1290 D
1,2-dichloropropane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
dibromomethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
bromodichloromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
cis-1,3-dichloropropene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
toluene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
trans-1,3-dichloropropene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1,2-trichloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
tetrachloroethylene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,3-dichloropropane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
dibromochloromethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2-dibromoethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
chlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
ethylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
xylenes (m/p)	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
o-xylene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
styrene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
bromoform	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
isopropyl benzene (cumene)	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
bromobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2,3-trichloropropane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
n-propyl benzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
2-chlorotoluene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
4-chlorotoluene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,3,5-trimethylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
tert-butylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2,4-trimethylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
sec-butylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,3-dichlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
4-isopropyltoluene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,4-dichlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2-dichlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
n-butylbenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2,4-trichlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
hexachlorobutadiene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
naphthalene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
1,2,3-trichlorobenzene	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
Methyl tertiary butyl ether	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
Acetone	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
carbon disulfide	NS	42.0 U	NS	NS	5.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U
2-butanone (MEK)	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
tetrahydrofuran (THF)	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
2-hexanone	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
2-chloroethyl vinyl ether	NS	84.0 U	NS	NS	10.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	153	NS	NS	223	40.6	47.4	76.6	43.8	NS	38.8	159
Ethane	NS	4.0 U	NS	NS	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	NS	4.0 U	2.0 U
Ethene	NS	1.8 J	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	NS	5.0 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0042 J	0.013	0.0048 J	0.0035 J	0.01 U	0.03 U	0.0033 J	0.008 U	0.0056 J	0.0099	0.0819	0.0051 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	4110	NS	NS	4540	NS	NS	NS	NS	NS	1660	NS
Manganese	NS	129	NS	NS	174	NS	NS	NS	NS	NS	75.3	NS
Arsenic	NS	2.05 J	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	4390	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	165	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	2.76	2.29	2.61	2.04	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	62.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U
Chloride	10.0	13.6	NS	15.4	20.2	4.30	13.4	15.8	15.3	NS	8.45	11.5
Nitrite as N	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U
Sulfate as SO4	33.1 D	38.5 E	NS	36.7 E	42.8 E	16.7	39.7 E	43.3 E	42.5 E	NS	10.3	27.4 D
Bromide	77.2	42.7	NS	11.2	8.84	0.66	3.71	3.53	1.71	NS	0.38	1.47
Nitrate as N	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U
O-Phosphate as P	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.21	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Formic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Pyruvic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	5.69	6.07	6.20	5.83	5.77	6.26	5.98	5.92	5.99	5.99	5.94	6.04
Temperature (°												

Table D.23. PMW-8S: Analytical and Field Parameter Results

Sample ID	PMW-8S
Lab Sample No.	9051-4
Sampling Date	12/18/2013
Time	737
Matrix	Water
VOCS (GC/MS)	µg/L
dichlorodifluoromethane	5.0 U
chloromethane	5.0 U
vinyl chloride	3.2 J
bromomethane	5.0 U
chloroethane	5.0 U
trichlorofluoromethane	5.0 U
1,1-dichloroethylene	3.48 J
methylene chloride	5.0 U
trans-1,2-dichloroethylene	1.49 J
1,1-dichloroethane	5.0 U
2,2-dichloropropane	5.0 U
cis 1,2- dichloroethylene	82.8
bromochloromethane	5.0 U
chloroform	5.0 U
1,1,1-trichloroethane	5.0 U
carbon tetrachloride	5.0 U
1,1-dichloropropene	5.0 U
benzene	5.0 U
1,2-dichloroethane	5.0 U
trichloroethylene	685
1,2-dichloropropane	5.0 U
dibromomethane	5.0 U
bromodichloromethane	5.0 U
cis-1,3-dichloropropene	5.0 U
toluene	5.0 U
trans-1,3-dichloropropene	5.0 U
1,1,2-trichloroethane	5.0 U
tetrachloroethylene	5.0 U
1,3-dichloropropane	5.0 U
dibromochloromethane	5.0 U
1,2-dibromoethane	5.0 U
chlorobenzene	5.0 U
1,1,1,2-tetrachloroethane	5.0 U
ethylbenzene	5.0 U
xlenes (m/p)	5.0 U
o-xylene	5.0 U
styrene	5.0 U
bromoform	5.0 U
isopropyl benzene (cumene)	5.0 U
bromobenzene	5.0 U
1,1,2,2-tetrachloroethane	5.0 U
1,2,3-trichloropropane	5.0 U
n-propyl benzene	5.0 U
2-chlorotoluene	5.0 U
4-chlorotoluene	5.0 U
1,3,5-trimethylbenzene	5.0 U
tert-butylbenzene	5.0 U
1,2,4-trimethylbenzene	5.0 U
sec-butylbenzene	5.0 U
1,3-dichlorobenzene	5.0 U
4-isopropyltoluene	5.0 U
1,4-dichlorobenzene	5.0 U
1,2-dichlorobenzene	5.0 U
n-butylbenzene	5.0 U
1,2-dibromo-3-chloropropane	5.0 U
1,2,4-trichlorobenzene	5.0 U
hexachlorobutadiene	5.0 U
naphthalene	5.0 U
1,2,3-trichlorobenzene	5.0 U
Methyl tertiary butyl ether	5.0 U
Acetone	10.0 U
carbon disulfide	5.0 U
2-butanone (MEK)	10.0 U
tetrahydrofuran (THF)	10.0 U
4-methyl-2-pentanone (MIBK)	10.0 U
2-hexanone	10.0 U
2-chloroethyl vinyl ether	10.0 U
REDUCED GASES (GC)	µg/L
Methane	71.8
Ethane	2.0 U
Ethene	2.5 U
OTHER GASES	µg/L
Hydrogen	0.0031 J
METALS (DISSOLVED)	µg/L
Iron	NS
Manganese	NS
Arsenic	NS
METALS (TOTAL)	µg/L
Iron	NS
Manganese	NS
GROUNDWATER CHEMISTRY	mg/L
Total Organic Carbon (TOC)	NS
Dissolved Organic Carbon (DOC)	NS
Alkalinity as CaCO ₃	NS
ANIONS	mg/L
Fluoride	0.2 U
Chloride	5.17
Nitrite as N	0.2 U
Sulfate as SO ₄	13.7
Bromide	0.31
Nitrate as N	0.2 U
O-Phosphate as P	0.17 J
VOLATILE FATTY ACIDS	mg/L
Lactic Acid	NS
Acetic Acid	NS
Propionic Acid	NS
Formic Acid	NS
Butyric Acid	NS
Pyruvic Acid	NS
Valeric Acid	NS
FIELD PARAMETERS	
pH (SU)	6.32
Temperature (°C)	14.63
Dissolved Oxygen (DO; mg/L)	0.46
Redox Potential (ORP; mV)	16.1
Conductivity (µS/cm)	154
Depth to Water (ft-btoc)	8.13
qPCR	cells/mL
DHC	NS

Table D.24. PMW-8I: Analytical and Field Parameter Results

Sample ID	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i	PMW-8i
Lab Sample No.	8698-12	8708-11	8713-22	8717-21	6/15/2012	6/19/2012	8767-8	8/16/2012	8807-6	8818-6	8837-9	8839-9	8840-10
Sampling Date	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012	7/30/2012	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012
Time	170	178	182	184	186	190	231	248	262	275	294	295	296
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	239	D	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1-dichloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	3740	D	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
dloromomethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
dlbromochloromethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
xlenes (m/p)	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2-dibrom-3-chloropropane	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	105	U	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	210	U	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	NS	221	NS	NS	NS	NS	NS	NS
Ethane	NS	NS	NS	NS	NS	NS	4.0	U	NS	NS	NS	NS	NS
Ethene	NS	NS	NS	NS	NS	NS	5.0	U	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0059	J	0.009	U	NS	NS	0.009	U	NS	0.009	U	0.0184	0.0103
0.0074	J	0.0038	J										
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (ORP)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	NS	NS	0.2	U	NS	0.2	U	1.0	U
Chloride	7.52	11.7	12.3	NS	NS	NS	14.5	NS	18.5	8.51	9.07	11.2	9.93
Nitrite as N	0.2	U	0.2	U	0.2	U	NS	NS	0.2	U	0.2	U	1.0
Sulfate as SO4	23.2	E	48.8	E	54.0	E	NS	NS	57.1	E	NS	62.3	D
25.1	D	4.07	D	12.3	D	27.9	D						
Bromide	2.21	3.76	3.31	2.97	3.02	2.98	3.47	NS	2.00	0.92	1.0	U	0.54
Nitrate as N	0.2	U	0.2	U	0.2	U	NS	NS	0.2	U	0.2	U	1.0
O-Phosphate as P	0.2	U	0.2	U	0.2	U	NS	NS	0.2	U	0.2	U	1.0
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Pyruvic Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	U	NS	NS
FIELD PARAMETERS													
pH (SU)	5.85	5.91	5.99	5.92	5.86	5.95	5.44	5.71	5.91	6.08	5.79	5.95	5.66
Temperature (°C)	15.42	16.05	16.51	16.03	16.08	15.94	17.10	17.55	17.35	17.40	17.62	17.66	19.97
Dissolved Oxygen (DO; mg/L)	1.09	0.83	1.13	0.16	0.85	0.88	0.07	0.12	0.40	3.49	0.80	0.22	0.18
Redox Potential (ORP; mV)	-105.8	-59.4	-52.2	-64.5	-37.4	-71.4	-174.1	-158.4	-140.3	-73.1	23.5	7.5	30.6
Conductivity (µS/cm)	169	294	323	317	310	317	327	355	367	251	214	246	314
Depth to Water (ft-bloc)	NS	NS	NS	8.81	8.11	8.10	8.21	NS	9.27	9.21	7.32	8.38	8.27
7.96													
qPCR	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
DHC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.24. PMW-8I: Analytical and Field Parameter Results

Sample ID	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I	PMW-8I
Lab Sample No.	8850-10	8852-10	8869-10	8876-9	8883-5	8896-6	8905-6	8929-6	8954-10	8977-10	8993-5	9017-5	9040-6
Sampling Date	10/5/2012	10/23/2012	11/5/2012	12/4/2012	12/18/2012	1/17/2013	2/7/2013	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013	11/12/2013
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCs (GCMS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
chloromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
vinyl chloride	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	13.1 U
bromomethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
chloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
trichlorofluoromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1-dichloroethylene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	2.5 J	25.0 U	NS	1.2 J	7.9 J	14.3 J
methylene chloride	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	4.5 J	6.49 J
1,1-dichloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
2,2-dichloropropane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
cis-1,2-dichloroethylene	NS	196 D	NS	NS	132 D	25.3 J	72.2 D	78.0 D	87.2 D	NS	220 J	605 J	450 J
bromochloromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
chloroform	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
carbon tetrachloride	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1-dichloropropene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
benzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2-dichloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
trichloroethylene	NS	1860 D	NS	NS	2180 D	171 J	992 D	1040 D	1480 D	NS	489 J	992 J	2320 J
1,2-dichloropropane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
dibromomethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
bromodichloromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
toluene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
trans-1,3-dichloropropene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
tetrachloroethylene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,3-dichloropropane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
dibromochloromethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2-dibromoethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
chlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
ethylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
xylene (m/p)	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
o-xylene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
styrene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
bromoform	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
bromobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
n-propyl benzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
2-chlorotoluene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
4-chlorotoluene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
tert-butylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
sec-butylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
4-isopropyltoluene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
n-butylbenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
hexachlorobutadiene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
naphthalene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	NS	42.0 U	NS	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U
Acetone	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
carbon disulfide	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	5.0 U	5.0 U	5.0 U
2-butanone (MEK)	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
2-hexanone	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether	NS	84.0 U	NS	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	182	NS	NS	225	28.5	51.7	79.4	41.6	NS	51.0	530	196
Ethane	NS	1.1 J	NS	NS	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	NS	4.0 U	2.0 U	2.0 U
Ethene	NS	2.4 J	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	NS	5.0 U	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0040 J	0.0059 J	0.0077 J	0.0037 J	0.0035 J	0.03 U	0.0033 J	0.0092	0.0079 J	0.0122	0.0320	0.0049 J	0.0048 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	6790 D	NS	NS	6780 D	NS	NS	NS	NS	NS	1910 D	NS	NS
Manganese	NS	116 D	NS	NS	170 D	NS	NS	NS	NS	NS	41.9 D	NS	NS
Arsenic	NS	2.5 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	6850 D	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	169 D	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	3.40	2.93	2.64	2.42	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	69.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
Chloride	9.86	13.4	NS	14.7	20.9	2.16	13.0	15.6	15.4	NS	7.41	11.4	14.8
Nitrite as N	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
Sulfate as SO4	23.4 D	38.9 E	NS	34.5 E	42.8 E	16.7	38.1 E	41.2 E	41.3 E	NS	8.05	17.2	33.5 D
Bromide	110	34.1	NS	11.7	9.51	0.61	4.71	5.08	1.96	NS	0.39	1.52	1.89
Nitrate as N	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U
O-Phosphate as P	1.0 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.19 J	0.2 U	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	0.2 U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS
Formic Acid	NS	NS</											

Table D.24. PMW-8I: Analytical and Field Parameter Results

Sample ID	PMW-8I
Lab Sample No.	9051-5
Sampling Date	12/18/2013
Time	737
Matrix	Water
VOCS (GC/MS)	µg/L
dichlorodifluoromethane	5.0 U
chloromethane	5.0 U
vinyl chloride	3.49 J
bromomethane	5.0 U
chloroethane	5.0 U
trichlorofluoromethane	5.0 U
1,1-dichloroethylene	3.98 J
methylene chloride	5.0 U
trans-1,2-dichloroethylene	2.21 J
1,1-dichloroethane	5.0 U
2,2-dichloropropane	5.0 U
cis 1,2- dichloroethylene	136
bromochloromethane	5.0 U
chloroform	5.0 U
1,1,1-trichloroethane	5.0 U
carbon tetrachloride	5.0 U
1,1-dichloropropene	5.0 U
benzene	5.0 U
1,2-dichloroethane	5.0 U
trichloroethylene	1030
1,2-dichloropropane	5.0 U
dibromomethane	5.0 U
bromodichloromethane	5.0 U
cis-1,3-dichloropropene	5.0 U
toluene	5.0 U
trans-1,3-dichloropropene	5.0 U
1,1,2-trichloroethane	5.0 U
tetrachloroethylene	5.0 U
1,3-dichloropropane	5.0 U
dibromochloromethane	5.0 U
1,2-dibromoethane	5.0 U
chlorobenzene	5.0 U
1,1,1,2-tetrachloroethane	5.0 U
ethylbenzene	5.0 U
xlenes (m/p)	5.0 U
o-xylene	5.0 U
styrene	5.0 U
bromoform	5.0 U
isopropyl benzene (cumene)	5.0 U
bromobenzene	5.0 U
1,1,2,2-tetrachloroethane	5.0 U
1,2,3-trichloropropane	5.0 U
n-propyl benzene	5.0 U
2-chlorotoluene	5.0 U
4-chlorotoluene	5.0 U
1,3,5-trimethylbenzene	5.0 U
tert-butylbenzene	5.0 U
1,2,4-trimethylbenzene	5.0 U
sec-butylbenzene	5.0 U
1,3-dichlorobenzene	5.0 U
4-isopropyltoluene	5.0 U
1,4-dichlorobenzene	5.0 U
1,2-dichlorobenzene	5.0 U
n-butylbenzene	5.0 U
1,2-dibromo-3-chloropropane	5.0 U
1,2,4-trichlorobenzene	5.0 U
hexachlorobutadiene	5.0 U
naphthalene	5.0 U
1,2,3-trichlorobenzene	5.0 U
Methyl tertiary butyl ether	5.0 U
Acetone	10.0 U
carbon disulfide	5.0 U
2-butanone (MEK)	10.0 U
tetrahydrofuran (THF)	10.0 U
4-methyl-2-pentanone (MIBK)	10.0 U
2-hexanone	10.0 U
2-chloroethyl vinyl ether	10.0 U
REDUCED GASES (GC)	µg/L
Methane	129
Ethane	2.0 U
Ethene	2.5 U
OTHER GASES	µg/L
Hydrogen	0.0066 J
METALS (DISSOLVED)	µg/L
Iron	NS
Manganese	NS
Arsenic	NS
METALS (TOTAL)	µg/L
Iron	NS
Manganese	NS
GROUNDWATER CHEMISTRY	mg/L
Total Organic Carbon (TOC)	NS
Dissolved Organic Carbon (DOC)	NS
Alkalinity as CaCO3	NS
ANIONS	mg/L
Fluoride	0.2 U
Chloride	5.87
Nitrite as N	0.2 U
Sulfate as SO ₄	15.6
Bromide	0.38
Nitrate as N	0.2 U
O-Phosphate as P	0.22
VOLATILE FATTY ACIDS	mg/L
Lactic Acid	NS
Acetic Acid	NS
Propionic Acid	NS
Formic Acid	NS
Butyric Acid	NS
Pyruvic Acid	NS
Valeric Acid	NS
FIELD PARAMETERS	
pH (SU)	6.34
Temperature (°C)	14.64
Dissolved Oxygen (DO; mg/L)	0.34
Redox Potential (ORP; mV)	-11.3
Conductivity (µS/cm)	156
Depth to Water (ft-btoc)	9.01
qPCR	cells/mL
DHC	NS

Table D.25. PMW-8D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D
Lab Sample No.	POLs and	8533-20	8539-3	8546-22	8547-22	8550-24	8551-22	8556-6	8561-8	8563-6	8596-8	8649-9	8652-22	8696-13	8708-12
Sampling Date	GW Quality	10/26/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/6/2011	12/12/2011	1/16/2012	2/7/2012	3/27/2012	4/3/2012	5/30/2012	6/7/2012
Time		-46	-33	-24	-21	-19	-14	-6	0	35	57	106	113	170	178
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
vinyl chloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromomethane	10	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloroethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trichlorofluoromethane	2000	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1-dichloroethylene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	2.1 J	NS	NS	NS
methylene chloride	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	2.3 J	NS	NS	NS
1,1-dichloroethane	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
cis-1,2-dichloroethylene	70	41.5 D	19.0	NS	NS	NS	NS	NS	NS	NS	NS	183	NS	NS	NS
bromochloromethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloroform	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1-trichloroethane	30	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
carbon tetrachloride	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1-dichloropropene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
benzene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dichloroethane	2	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trichloroethylene	1	1640 D	453	NS	NS	NS	NS	NS	NS	NS	NS	645	NS	NS	NS
1,2-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
dibromomethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromodichloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
toluene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,2-trichloroethane	3	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
tetrachloroethylene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3-dichloropropane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
dibromochloromethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dibromoethane		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chlorobenzene	50	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
ethylbenzene	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
xylene (m/p)	1000	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
o-xylene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
styrene	100	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromoforn	4	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
isopropylbenzene (cumene)	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
n-propyl benzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
4-chlorotoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3,5-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
tert-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,4-trimethylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
sec-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
4-isopropyltoluene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,4-dichlorobenzene	75	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dichlorobenzene	600	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
n-butylbenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
hexachlorobutadiene	1	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
naphthalene	300	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,3-trichlorobenzene		25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
Acetone	6000	50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
carbon disulfide	700	25.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2-butanone (MEK)	300	50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	15.2	NS	NS	NS
tetrahydrofuran (THF)	10	50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
2-hexanone		50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
2-chloroethyl vinyl ether		50.0 U	10.0 U	NS	NS	NS	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	97.0	99.8	NS	NS	NS	NS	NS	NS	NS	NS	1430	NS	NS	NS
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS	0.46 J	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.009 U	0.0057 J	NS	NS	NS	NS	NS	0.0055	0.0021 J	0.008 U	0.0094	0.008 U	0.0081 J	0.004 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5920 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	102 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NA	NS	NS	NS	NS	NS	NS	11.2	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NA	NS	NS	NS	NS	NS	NS	10.5	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	13.2	12.6	NS	NS	NS	NS	NS	NS	NS	NS	22.8	NS	19.4	21.8
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
Sulfate as SO4	250	47.0 E	67.6 E	NS	NS	NS	NS	NS	NS	NS	NS	96.2 D	NS	78.7 E	94.2 E
Bromide	NA	0.49	0.49	1.27	1.63	0.54	3.28	NS	NS	NS	NS	2.17	NS	1.86	2.32
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.53	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	0.67 J	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS							

Table D.25. PMW-8D: Analytical and Field Parameter Results

Sample ID	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D
Lab Sample No.	8713-5	8717-22			8767-9		8807-7	8818-7	8837-10	8839-10	8840-9	8850-9	8852-11	8869-9
Sampling Date	6/11/2012	6/13/2012	6/15/2012	6/19/2012	7/30/2012	8/16/2012	8/30/2012	9/12/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012
Time	182	184	186	190	231	248	262	275	294	295	296	298	316	339
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
chloromethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
vinyl chloride	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
bromomethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
chloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
trichlorofluoromethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1-dichloroethylene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	4.3 J	NS
methylene chloride	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1-dichloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
2,2-dichloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
cis 1,2-dichloroethylene	NS	NS	NS	NS	275 D	NS	NS	NS	NS	NS	NS	NS	206 D	NS
bromochloromethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
chloroform	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,1-trichloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
carbon tetrachloride	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1-dichloropropene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
benzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2-dichloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
trichloroethylene	NS	NS	NS	NS	1590 D	NS	NS	NS	NS	NS	NS	NS	1960 D	NS
1,2-dichloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,1,1-tetrachloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,3-dichloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,2,2-tetrachloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2-dibromomethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
chlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
ethylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
xylenes (m/p)	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
o-xylene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
styrene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
bromoforn	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
bromobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2,3-trichloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
n-propyl benzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
2-chlorotoluene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
4-chlorotoluene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
tert-butylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
sec-butylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,3-dichlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
4-isopropyltoluene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,4-dichlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
2-dichlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
n-butylbenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
hexachlorobutadiene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
naphthalene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
Acetone	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
carbon disulfide	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	42.0 U	NS
2-butanone (MEK)	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
2-hexanone	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	84.0 U	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	1110	NS	NS	NS	NS	NS	NS	NS	857	NS
Ethane	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS	NS	NS	2.7 J	NS
Ethene	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS	NS	NS	8.5	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS	NS	0.009 U	NS	0.009 U	0.0483	0.0030 J	0.0046 J	0.0034 J	0.0010 J	0.009 U	0.0038 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	13300 D	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	111 D	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.5 U	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	61.6	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	NS	NS	NS	NS	0.2 U	NS	0.2 U	0.34	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS
Chloride	23.7 E	NS	NS	NS	24.1	NS	21.7	4.65	12.7	13.0	11.3	12.9	12.5	NS
Nitrite as N	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS
Sulfate as SO4	97.2 E	NS	NS	NS	85.8 E	NS	90.1 D	4.12	21.3 D	22.9 D	22.6 D	27.9 D	28.8 E	NS
Bromide	2.69	2.53	2.77	2.94	3.13	NS	4.50	0.31	1.00 J	2.00	65.9	31.3	77.5	NS
Nitrate as N	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS
O-Phosphate as P	0.2 U	NS	NS	NS	0.2 U	NS	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS
Acetic Acid	NS	NS	NS	NS	NS	NS	NS	1.56	NS	NS	NS	NS	NS	NS
Propionic Acid	NS	NS	NS	NS	NS	NS	NS	0.91 J	NS	NS	NS	NS	NS	NS
Formic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS
Butyric Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS
Pyrucic Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS
Valeric Acid	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS														
pH (SU)	5.87	5.84	5.82	5.84	5.52	5.54	5.88	6.11	5.85	5.86	5.83	5.63	5.99	6.15
Temperature (°C)	16.34	15.85	15.75	15.85	17.20	17.50	16.95	17.83	17.26	17.19	17.46	17.04	16.50	13.30
Dissolved Oxygen (DO; mg/L)	0.12	-0.01	0.65	0.14	0.07	0.12	0.38	3.42	1.66	0.25	0.13	0.23	0.10	0.23
Redox Potential (ORP; mV)	-60.0	-75.1	-56.1	-79.1	-167.7	-160.7	-123.1	-73.2	12.7	9.6	23.2	26.3	-102.6	-76
Conductivity (µS/cm)	463	464	485	481	468	449	472	153	297	301	249	280	350	176
Depth to Water (ft-bloc)	7.87	7.62	7.95	7.84	NS	7.54	8.50	7.46	7.94	8.23	7.96	7.80	8.44	7.36
qPCR	cells/mL	cells/mL	cells/mL											

Table D.25. PMW-8D: Analytical and Field Parameter Results

Sample ID	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D	PMW-8D
Lab Sample No.	8876-10	8883-6	8896-7	8905-7	8929-7	8954-11	8977-11	8993-6	9017-6	9040-7	9051-6
Sampling Date	12/4/2012	12/18/2012	1/17/2013	2/7/2013	3/14/2013	4/24/2013	6/11/2013	7/2/2013	9/17/2013	11/12/2013	12/18/2013
Time	358	372	402	423	458	499	547	568	645	701	737
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1,1-dichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
vinyl chloride	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	15.5 J	2.23 J
bromomethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trichlorofluoromethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloroethylene	NS	42.0 U	5.0 U	25.0 U	4.8 J	4.6 J	NS	0.6 J	11.0 J	10.7 J	1.96 J
methylene chloride	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trans-1,2-dichloroethylene	NS	42.0 U	5.0 U	25.0 U	2.3 J	2.5 U	NS	5.0 U	6.6 J	6.03 J	1.49 J
1,1-dichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2,2-dichloropropane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,2-dichloroethylene	NS	207 D	45.1 J	167 D	165 J	170 D	NS	86.4 J	1110 D	815 J	146 J
bromochloromethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chloroform	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,1-trichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
carbon tetrachloride	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1-dichloropropene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
benzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	1.0 J	5.0 U
1,2-dichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
trichloroethylene	NS	1830 D	531 J	1420 D	1710 D	1810 D	NS	179 J	1550 D	2130 D	611 J
1,2-dichloropropane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
dibromomethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromodichloromethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
cis-1,3-dichloropropene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
toluene	NS	42.0 U	2.1 J	25.0 U	5.0 U	25.0 U	NS	5.0 U	17.0 J	5.37 J	1.9 J
trans-1,3-dichloropropene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2-trichloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
tetrachloroethylene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3-dichloropropane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
dibromochloromethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromoethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
chlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,1,2-tetrachloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
ethylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
xylene (m/p)	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
o-xylene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
styrene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromoform	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
isopropyl benzene (cumene)	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
bromobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,1,2,2-tetrachloroethane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichloropropane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
n-propyl benzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2-chlorotoluene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
4-chlorotoluene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3,5-trimethylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
tert-butylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trimethylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
sec-butylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,3-dichlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
4-isopropyltoluene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,4-dichlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dichlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
n-butylbenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2-dibromo-3-chloropropane	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,4-trichlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
hexachlorobutadiene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
naphthalene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
1,2,3-trichlorobenzene	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
Methyl tertiary butyl ether	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
carbon disulfide	NS	42.0 U	5.0 U	25.0 U	5.0 U	25.0 U	NS	5.0 U	5.0 U	5.0 U	5.0 U
2-butanone (MEK)	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
tetrahydrofuran (THF)	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
4-methyl-2-pentanone (MIBK)	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
2-hexanone	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
2-chloroethyl vinyl ether	NS	84.0 U	10.0 U	50.0 U	10.0 U	50.0 U	NS	10.0 U	10.0 U	10.0 U	10.0 U
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	1030 J	101 J	227 J	225 J	233 J	NS	70.0 J	733 J	862 J	257 J
Ethane	NS	2.40 J	4.0 U	4.0 U	4.0 U	4.0 U	NS	4.0 U	2.0 U	2.0 U	2.0 U
Ethene	NS	5.91 J	5.0 U	1.28 J	5.0 U	5.0 U	NS	5.0 U	2.5 U	2.5 U	2.5 U
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.0041 J	0.0041 J	0.03 U	0.032 J	0.008 U	0.008 U	0.0089 J	0.0441 J	0.0167 J	0.0052 J	0.0072 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	9860 D	NS	NS	NS	NS	NS	2320 D	NS	NS	NS
Manganese	NS	105 D	NS	NS	NS	NS	NS	34.5 D	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	10100 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	NS	107 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Total Organic Carbon (TOC)	NS	NS	2.89 J	3.89 J	NS	4.00 J	NS	NS	NS	NS	NS
Dissolved Organic Carbon (DOC)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alkalinity as CaCO3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Chloride	14.6 J	16.4 J	2.05 J	11.6 J	14.0 J	11.6 J	NS	4.54 J	12.1 J	12.5 J	3.29 J
Nitrite as N	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
Sulfate as SO4	31.6 E	32.5 E	13.5 J	29.9 E	34.3 E	30.9 E	NS	0.25 J	11.5 J	18.8 J	8.46 J
Bromide	13.4 J	15.0 J	0.75 J	9.68 J	10.2 J	6.15 J	NS	0.32 J	2.54 J	2.00 J	0.19 J
Nitrate as N	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.2 U	0.2 U	0.2 U	0.2 U
O-Phosphate as P	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NS	0.18 J	0.18 J	0.18 J	0.2 U
VOLATILE FATTY ACIDS	mg/L	0.2 U	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Acetic Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Propionic Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Formic Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Butyric Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Pyruvic Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
Valeric Acid	NS	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NS	NS	NS	NS	NS
FIELD PARAMETERS											
pH (SU)	5.87	5.74	6.15	5.94	5.81	5.86	6.01	6.23	5.99	5.86	6.24
Temperature (°C)	16.21	16.07	13.59	12.97	13.28	14.03	15.13	16.04	16.73	15.21	14.74
Dissolved Oxygen (DO: mg/L)	0.18	0.41	0.36	0.63	0.17	0.40	0.41	0.20	0.10	0.07	0.24
Redox Potential (ORP: mV)	-100.5	-43.2	-24.6	-109.7	-22.5	-10.0	35.6	-40.7	-82.0	-191.8	1.8
Conductivity (µS/cm)	326	316	82	290	261	229					

Table D.26. PMW-9S: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S	PMW-9S
Lab Sample No.	POLs and	8533-19	8539-4	8546-23	8547-23	8550-25	8551-23	8561-9	8649-10	8652-14	8713-25	8717-23
Sampling Date	GW Quality	10/26/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/12/2011	3/27/2012	4/3/2012	6/11/2012	6/13/2012
Time		-46	-32	-24	-21	-19	-14	0	106	113	182	184
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
vinyl chloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromomethane	10	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloroethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	1.8 J	NS	NS	NS
methylene chloride	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1-dichloroethane	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2,2-dichloropropane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
cis-1,2-dichloroethylene	70	81.3 D	65.9	NS	NS	NS	NS	NS	64.8	NS	NS	NS
bromochloromethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chloroform	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
carbon tetrachloride	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1-dichloropropene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
benzene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dichloroethane	2	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trichloroethylene	1	2140 D	2160 D	NS	NS	NS	NS	NS	3120 D	NS	NS	NS
1,2-dichloropropane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1-trichloroethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromodichloromethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
toluene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
tetrachloroethylene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3-dichloropropane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1-trichloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dibromoethane		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
chlorobenzene	50	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
ethylbenzene	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
xylene (m/p)	1000	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
o-xylene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
styrene	100	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromoform	4	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
bromobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
n-propyl benzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
4-chlorotoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
tert-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
sec-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
4-isopropyltoluene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
n-butylbenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
hexachlorobutadiene	1	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
naphthalene	300	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
Acetone	6000	100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
carbon disulfide	700	50.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
2-butanone (MEK)	300	100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
2-hexanone		100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	10.0 U	NS	NS	NS	NS	NS	10.0 U	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	38.2	42.6	NS	NS	NS	NS	NS	46.4	NS	NS	NS
Ethane	NA	2.05 J	1.17 J	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS
Ethene	NA	2.51 J	1.13 J	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.009 U	0.0053 J	NS	NS	NS	NS	0.0023 J	0.01 U	0.008 U	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5540	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	145	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	14.3	12.5	NS	NS	NS	NS	NS	8.47	NS	12.0	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS
Sulfate as SO ₄	250	102 E	82.3 E	NS	NS	NS	NS	NS	46.7 D	NS	53.2 E	NS
Bromide	NA	0.40	0.37	3.47	2.72	0.59	3.09	NS	0.68	NS	2.45	2.48
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.84	5.74	NS	NS	NS	NS	5.68	5.95	5.99	4.87	4.83
Temperature (°C)	NA	16.64	16.42	NS	NS	NS	NS	15.60	13.00	13.13	15.88	15.67
Dissolved Oxygen (DO; mg/L)	NA	0.17	0.32	NS	NS	NS	NS	0.06	0.00	0.71	1.76	0.31
Redox Potential (ORP; mV)	NA	-5.8	-84.4	NS	NS	NS	NS	-76.5	12.4	-101.0	78.0	89.3
Conductivity (µS/cm)	NA	530	395	NS	NS	NS	NS	289	311	286	200	193
Depth to Water (ft-btoc)	NA	6.72	6.93	NS	NS	NS	NS	6.55	7.35	7.23	7.65	7.55

Table D.26. PMW-9S: Analytical and Field Parameter Results

Sample ID	PMW-9S	PMW-9S
Lab Sample No.		
Sampling Date	6/15/2012	6/19/2012
Time	186	190
Matrix	Water	Water
VOCS (GC/MS)	µg/L	µg/L
dichlorodifluoromethane	NS	NS
chloromethane	NS	NS
vinyl chloride	NS	NS
bromomethane	NS	NS
chloroethane	NS	NS
trichlorofluoromethane	NS	NS
1,1-dichloroethylene	NS	NS
methylene chloride	NS	NS
trans-1,2-dichloroethylene	NS	NS
1,1-dichloroethane	NS	NS
2,2-dichloropropane	NS	NS
cis 1,2- dichloroethylene	NS	NS
bromochloromethane	NS	NS
chloroform	NS	NS
1,1,1-trichloroethane	NS	NS
carbon tetrachloride	NS	NS
1,1-dichloropropene	NS	NS
benzene	NS	NS
1,2-dichloroethane	NS	NS
trichloroethylene	NS	NS
1,2-dichloropropane	NS	NS
dibromomethane	NS	NS
bromodichloromethane	NS	NS
cis-1,3-dichloropropene	NS	NS
toluene	NS	NS
trans-1,3-dichloropropene	NS	NS
1,1,2-trichloroethane	NS	NS
tetrachloroethylene	NS	NS
1,3-dichloropropane	NS	NS
dibromochloromethane	NS	NS
1,2-dibromoethane	NS	NS
chlorobenzene	NS	NS
1,1,1,2-tetrachloroethane	NS	NS
ethylbenzene	NS	NS
xylene (m/p)	NS	NS
o-xylene	NS	NS
styrene	NS	NS
bromoform	NS	NS
isopropyl benzene (cumene)	NS	NS
bromobenzene	NS	NS
1,1,2,2-tetrachloroethane	NS	NS
1,2,3-trichloropropane	NS	NS
n-propyl benzene	NS	NS
2-chlorotoluene	NS	NS
4-chlorotoluene	NS	NS
1,3,5-trimethylbenzene	NS	NS
tert-butylbenzene	NS	NS
1,2,4-trimethylbenzene	NS	NS
sec-butylbenzene	NS	NS
1,3-dichlorobenzene	NS	NS
4-isopropyltoluene	NS	NS
1,4-dichlorobenzene	NS	NS
1,2-dichlorobenzene	NS	NS
n-butylbenzene	NS	NS
1,2-dibromo-3-chloropropane	NS	NS
1,2,4-trichlorobenzene	NS	NS
hexachlorobutadiene	NS	NS
naphthalene	NS	NS
1,2,3-trichlorobenzene	NS	NS
Methyl tertiary butyl ether	NS	NS
Acetone	NS	NS
carbon disulfide	NS	NS
2-butanone (MEK)	NS	NS
tetrahydrofuran (THF)	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS
2-hexanone	NS	NS
2-chloroethyl vinyl ether	NS	NS
REDUCED GASES (GC)	µg/L	µg/L
Methane	NS	NS
Ethane	NS	NS
Ethene	NS	NS
OTHER GASES	µg/L	µg/L
Hydrogen	NS	NS
METALS (DISSOLVED)	µg/L	µg/L
Iron	NS	NS
Manganese	NS	NS
ANIONS	mg/L	mg/L
Fluoride	NS	NS
Chloride	NS	NS
Nitrite as N	NS	NS
Sulfate as SO ₄	NS	NS
Bromide	2.64	2.48
Nitrate as N	NS	NS
O-Phosphate as P	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L
Lactic Acid	NS	NS
Acetic Acid	NS	NS
Propionic Acid	NS	NS
Formic Acid	NS	NS
Butyric Acid	NS	NS
Pyruvic Acid	NS	NS
Valeric Acid	NS	NS
FIELD PARAMETERS		
pH (SU)	4.87	4.72
Temperature (°C)	15.75	15.90
Dissolved Oxygen (DO; mg/L)	0.10	1.39
Redox Potential (ORP; mV)	83.7	72.4
Conductivity (µS/cm)	196	194
Depth to Water (ft-btoc)	7.45	7.40

Table D.27. PMW-9I: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I	PMW-9I
Lab Sample No.	PQLs and	8533-21	8539-5	8546-24	8547-24	8550-26	8551-24	8561-10	8649-11	8652-20	8713-23	8717-24	8717-24	8717-24
Sampling Date	GW Quality	10/26/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/12/2011	3/27/2012	4/3/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time		46	32	24	21	19	24	0	106	113	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
chloromethane		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
chloroethane		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	11.3 D	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
methylene chloride	3	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	3.3 JD	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	278 D	297 D	NS	NS	NS	NS	NS	296 JD	NS	NS	NS	NS	NS
bromochloromethane	70	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
chloroform	70	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
benzene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
trichloroethylene		22500	25400 D	NS	NS	NS	NS	NS	22500 D	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,3-dichloropropane		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
toluene	600	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	3	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,3-dichloropropane		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2-dibromoethane	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
xylene (m/p)	1000	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
p-xylene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
styrene	100	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
bromoform	4	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
bromobenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2,2-trichloroethane	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
n-propyl benzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
2-chlorotoluene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
4-chlorotoluene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
tert-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
sec-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
n-butylbenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	10.0 U	NS	NS	NS	NS	NS	350 U	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
2-hexanone		100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	20.0 U	NS	NS	NS	NS	NS	700 U	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	308	314	NS	NS	NS	NS	NS	295	NS	NS	NS	NS	NS
Ethane	NA	0.65 J	0.50 J	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS
Ethene	NA	1.53 J	0.97 J	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.008 J	0.0052 J	NS	NS	NS	NS	0.0025 J	0.01 U	0.0427	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	10600 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	147 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	28.1	29.2	NS	NS	NS	NS	NS	25.3	NS	21.0 E	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	104 E	103 E	NS	NS	NS	NS	NS	69.7 D	NS	63.7 E	NS	NS	NS
Bromide	NA	0.96	0.96	1.00	0.91	0.91	1.51	NS	1.11	NS	1.55	1.72	1.82	1.79
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS														
pH (SU)	NA	5.18	4.99	NS	NS	NS	NS	5.13	5.15	5.11	4.90	5.05	5.00	5.02
Temperature (°C)	NA	16.25	16.12	NS	NS	NS	NS	14.95	13.59	13.72	15.99	15.84	16.28	16.11
Dissolved Oxygen (DO, mg/L)	NA	0.20	0.60	NS	NS	NS	NS	0.11	0.21	0.69	0.65	0.20	1.92	1.23
Redox Potential (ORP, mV)	NA	38.9	78.9	NS	NS	NS	NS	-93.5	34.4	-117.1	36.9	8.5	22.2	3.4
Conductivity (µS/cm)	NA	440	378	NS	NS	NS	NS	392	338	266	259	265	264	255
Depth to Water (ft-btoc)	NA	12.95	13.43	NS	NS	NS	NS	11.85	-2.5	7.21	8.05	12.03	11.77	12.05

Table D.28. PMW-9D: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D	PMW-9D
Lab Sample No.	PQLs and	8533-22	8539-6	8546-25	8547-25	8550-27	8551-25	8561-11	8649-12	8652-21	8713-24	8717-25	8717-25	8717-25
Sampling Date	GW Quality	10/27/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	12/12/2011	3/27/2012	4/3/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time		45	32	24	21	19	24	0	106	113	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	4.5 D	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
ethylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	191 D	132 D	NS	NS	NS	NS	NS	223 D	NS	NS	NS	NS	NS
bromochloromethane	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trichloroethylene	1	7040	9610 D	NS	NS	NS	NS	NS	1050 D	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1-dibromomethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
dibromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
xylene (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
p-xylene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2-chlorotoluene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	182	190	NS	NS	NS	NS	NS	286	NS	NS	NS	NS	NS
Ethane	NA	0.46 J	0.51 J	NS	NS	NS	NS	NS	0.36 J	NS	NS	NS	NS	NS
Ethene	NA	0.74 J	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.0033 J	0.0045 J	J	NS	NS	NS	NS	0.0024 J	0.01 U	0.008 U	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	8510 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	304 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	21.9	20.6	NS	NS	NS	NS	NS	26.1	NS	19.8	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	78.0 E	77.6 E	NS	NS	NS	NS	NS	88.3 D	NS	62.5 E	NS	NS	NS
Bromide	NA	0.72	0.67	5.07	5.43	2.37	3.31	NS	1.25	NS	1.47	1.59	1.74	2.27
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS														
pH (SU)	NA	6.11	5.89	NS	NS	NS	NS	6.12	6.01	6.10	5.85	5.78	5.77	5.77
Temperature (°C)	NA	15.91	15.88	NS	NS	NS	NS	14.95	13.37	13.68	16.14	16.05	15.44	15.72
Dissolved Oxygen (DO, mg/L)	NA	0.45	0.32	NS	NS	NS	NS	0.01	0.23	0.67	1.15	0.01	0.79	0.60
Redox Potential (ORP, mV)	NA	-44.2	-46.3	NS	NS	NS	NS	-88.4	-133.5	-33.0	-38.4	-26.9	-49.0	-49.0
Conductivity (µS/cm)	NA	637	495	NS	NS	NS	NS	520	592	472	378	357	346	339
Depth to Water (ft-btoc)	NA	6.57	6.68	NS	NS	NS	NS	6.50	-2.6	7.30	7.62	7.48	7.71	7.61

Table D.30. PMW-10I: Analytical and Field Parameter Data

Sample ID	NJ Higher of	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I	PMW-10I
Lab Sample No.	POLs and	8534-3	8539-9	8543-16	8546-27	8547-27	8550-29	8551-27	8549-14	8652-17	8665-12	8698-15	8706-14	8713-27	8717-27	8713-27	8713-27
Sampling Date	GW Quality	10/2/2011	11/10/2011	11/16/2011	11/16/2011	11/21/2011	11/22/2011	11/28/2011	3/27/2012	4/30/2012	4/18/2012	5/30/2012	8/7/2012	8/11/2012	8/13/2012	8/15/2012	8/15/2012
Time		-45	-32	-26	-24	-21	-19	-14	106	113	128	170	178	182	184	186	190
Matrix	2000 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCs (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane	500	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	127 D	116 D	NS	NS	NS	NS	NS	113 D	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	1	1140 D	7000 D	NS	NS	NS	NS	NS	910 D	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromomethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
xylene (m)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m)	1000	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
bromofom	4	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropylbenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	0.02	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	50.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	NS	105 U	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	100.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
2-heptanone	100.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	100.0	50.0 U	25.0 U	NS	NS	NS	NS	NS	210 U	NS	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	167	172	NS	NS	NS	NS	NS	49.4	NS	NS	NS	NS	NS	NS	NS	NS
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS	NS	NS	NS
Ethane	NA	5.0 U	5.0 U	NS	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.005 J	0.005 J	NS	NS	NS	NS	NS	0.01 U	0.008 U	0.008 U	0.0086 U	0.006 J	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	3720 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	94.7 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	19.6	19.6	NS	NS	NS	NS	NS	13.4	NS	NS	14.3	15.9	14.2	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	0.2 U	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	70.0 E	64.4 E	NS	NS	NS	NS	NS	49.3 D	NS	NS	57.6 E	58.3 E	55.4 E	NS	NS	NS
Bromide	NA	0.63	0.58	0.79	2.81	3.68	1.63	1.81	1.50	NS	NS	1.56	1.49	1.59	1.61	1.65	1.87
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	NS	0.2 U	NS	NS	0.2 U	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS										

Table D.31. PMW-11S: Analytical and Field Parameter Data

Sample ID	NJ Higher of	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S	PMW-11S
Lab Sample No.	POLs and	8534-1	8539-10	8546-28	8547-28	8550-30	8551-28	8649-6	8665-13	8713-28	8717-28		
Sampling Date	GW Quality	10/27/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	4/18/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time		-45	-32	-24	-21	-19	-14	106	128	182	184	186	190
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	156 D	133 D	NS	NS	NS	NS	213 D	NS	NS	NS	NS	NS
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
trichloroethylene	1	9520 D	9520 D	NS	NS	NS	NS	11300 D	NS	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
dibromomethane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
dibromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2-dibromoethane		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
xylene (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	25.0 U	NS	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	50.0 U	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	157	151	NS	NS	NS	NS	196	NS	NS	NS	NS	NS
Ethane	NA	0.31 J	4.0 U	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS	NS
Ethene	NA	5.0 J	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004 J	0.004 J	NS	NS	NS	NS	0.01 U	0.008 U	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	5520 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	66.2 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	22.6	20.2	NS	NS	NS	NS	20.3	NS	14.3	NS	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	93.1 E	76.8 E	NS	NS	NS	NS	62.2 D	NS	62.5 E	NS	NS	NS
Bromide	NA	0.67	0.63	NS	7.82	4.94	3.74	0.86	NS	1.53	26.8	116	32.1
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	NA	5.49	5.14	NS	NS	NS	NS	5.17	4.29	4.58	4.25	4.21	4.29
Temperature (°C)	NA	16.19	16.24	NS	NS	NS	NS	13.31	13.75	15.52	15.04	14.68	15.03
Dissolved Oxygen (DO; mg/L)	NA	0.37	2.83	NS	NS	NS	NS	0.83	0.63	2.12	0.53	0.04	0.46
Redox Potential (ORP; mV)	NA	-70.3	1.2	NS	NS	NS	NS	11.0	100.4	89.5	96.0	91.6	80.1
Conductivity (µS/cm)	NA	430	268	NS	NS	NS	NS	297	221	217	249	367	259
Depth to Water (ft-bloc)	NA	6.94	7.15	NS	NS	NS	NS	7.45	7.65	7.68	7.84	8.01	8.04

Table D.32. PMW-11I: Analytical and Field Parameter Results

Sample ID	NJ Higher of	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I	PMW-11I
Lab Sample No.	POLs and	8534-2	8539-11	8546-29	8547-29	8550-31	8551-29	8649-7	8665-14	8713-26	8717-29	
Sampling Date	GW Quality	10/27/2011	11/10/2011	11/18/2011	11/21/2011	11/23/2011	11/28/2011	3/27/2012	4/18/2012	6/11/2012	6/13/2012	6/15/2012
Time		-45	-32	-24	-21	-19	-14	106	128	182	184	186
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloromethane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
vinyl chloride	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromomethane	10	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroethane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichlorofluoromethane	2000	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethylene	1	50.0 U	7.7 D	NS	NS	NS	NS	105 U	NS	NS	NS	NS
methylene chloride	3	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloroethane	50	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2,2-dichloropropane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis 1,2-dichloroethylene	70	187 D	161 D	NS	NS	NS	NS	152 D	NS	NS	NS	NS
bromochloromethane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chloroform	70	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1-trichloroethane	30	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
carbon tetrachloride	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1-dichloropropene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
benzene	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichloroethane	2	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trichloroethylene	1	17700 D	15700 D	NS	NS	NS	NS	11900 D	NS	NS	NS	NS
1,2-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tribromomethane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromodichloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
cis-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
toluene	600	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
trans-1,3-dichloropropene	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2-trichloroethane	3	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tetrachloroethylene	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichloropropane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tribromochloromethane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromomethane		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
chlorobenzene	50	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
ethylbenzene	700	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
xylenes (m/p)	1000	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
o-xylene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
styrene	100	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromoform	4	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
isopropyl benzene (cumene)	700	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
bromobenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-propyl benzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-chlorotoluene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3,5-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
tert-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trimethylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
sec-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,3-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
4-isopropyltoluene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,4-dichlorobenzene	75	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dichlorobenzene	600	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
n-butylbenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
hexachlorobutadiene	1	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
naphthalene	300	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
1,2,3-trichlorobenzene		50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Methyl tertiary butyl ether	70	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
Acetone	6000	100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
carbon disulfide	700	50.0 U	25.0 U	NS	NS	NS	NS	105 U	NS	NS	NS	NS
2-butanone (MEK)	300	100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
tetrahydrofuran (THF)	10	100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-hexanone		100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
2-chloroethyl vinyl ether		100.0 U	50.0 U	NS	NS	NS	NS	210 U	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	250	203	NS	NS	NS	NS	215	NS	NS	NS	NS
Ethane	NA	4.0 U	4.0 U	NS	NS	NS	NS	4.0 U	NS	NS	NS	NS
Ethene	NA	5.0 U	5.0 U	NS	NS	NS	NS	5.0 U	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.004 J	0.007 J	NS	NS	NS	NS	0.01 U	0.008 U	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	NS	7970 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	NS	112 D	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	0.2 U	0.2 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	24.8	21.8	NS	NS	NS	NS	20.4	NS	24.1 E	NS	NS
Nitrite as N	1	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS
Sulfate as SO ₄	250	87.5 E	120 E	NS	NS	NS	NS	82.9 D	NS	67.4 E	NS	NS
Bromide	NA	0.67	0.73	0.85	0.79	0.36	0.58	0.95	NS	0.91	0.84	0.96
Nitrate as N	10	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS
O-Phosphate as P	NA	0.2 U	0.2 U	NS	NS	NS	NS	0.2 U	NS	0.2 U	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Propionic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Formic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Butyric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pyruvic Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
Valeric Acid	NA	NS	1.0 U	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	5.52	5.60	NS	NS	NS	NS	5.87	5.33	5.70	5.72	5.77
Temperature (°C)	NA	16.14	16.14	NS	NS	NS	NS	13.65	14.10	16.00	15.31	15.00
Dissolved Oxygen (DO; mg/L)	NA	0.39	5.90	NS	NS	NS	NS	0.86	0.60	6.11	0.14	-0.23
Redox Potential (ORP; mV)	NA	-62.5	-41.9	NS	NS	NS	NS	4.7	43.2	-8.0	-30.8	-49.6
Conductivity (µS/cm)	NA	426	447	NS	NS	NS	NS	485	392	370	379	381
Depth to Water (ft-bloc)	NA	6.67	10.38	NS	NS	NS	NS	7.45	9.50	9.57	9.44	9.51

Table D.33. CW-1: Analytical and Field Parameter Results

Sample ID	NJ Higher of	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1
Lab Sample No.	POLs and	8543-17	8561-14	8573-6	8576-2	8577-2	8581-2						
Sampling Date	GW Quality	11/16/2011	12/13/2011	12/28/2011	1/5/2012	1/9/2012	1/12/2012	1/16/2012	1/19/2012	2/7/2012	3/26/2012	4/3/2012	4/18/2012
Time (days)		-26	1	16	24	28	31	35	38	57	105	113	128
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis 1,2- dichloroethylene	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m/p)	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	6000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	NS	0.0093	0.255	26.7	267	261	NS	NS	NS	310	1131	1210
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Chloride	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrite as N	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate as SO ₄	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bromide	NA	0.59	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrate as N	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
O-Phosphate as P	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS													
pH (SU)	NA	NS	3.96	NS	5.33	6.01	6.66	6.91	9.18	9.96	9.98	10.69	11.31
Temperature (°C)	NA	NS	15.18	NS	13.8	13.7	13.87	13.50	13.41	13.65	12.60	13.72	13.42
Dissolved Oxygen (DO; mg/L)	NA	NS	3.42	NS	1.92	1.54	1.35	2.19	1.30	-0.09	2.17	0.57	0.94
Redox Potential (ORP; mV)	NA	NS	340.4	NS	53.0	-217.5	-515.9	-285.8	-368.8	-410.3	-311.4	-351.6	-428.2
Conductivity (µS/cm)	NA	NS	481	NS	228.3	244.5	254	257	268	293	354	405	553
Depth to Water (ft-btoc)	NA	NS	7.13	NS	7.07	6.90	7.04	NS	NS	NS	7.45	NS	NS

Table D.33. CW-1: Analytical and Field Parameter Results

Sample ID	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1	CW-1
Lab Sample No.	8685-1								
Sampling Date	5/9/2012	5/11/2012	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time (days)	149	151	161	170	178	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
di bromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
di bromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylene (m/p)	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoforn	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropytlouene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Chloride	NS	NS	NS	NS	NS	3.38	NS	NS	NS
Nitrite as N	NS	NS	NS	NS	NS	0.2	U	NS	NS
Sulfate as SO ₄	NS	NS	NS	NS	NS	27.9	E	NS	NS
Bromide	NS	NS	NS	NS	NS	0.30	1850	2310	32.8
Nitrate as N	NS	NS	NS	NS	NS	0.2	U	NS	NS
O-Phosphate as P	NS	NS	NS	NS	NS	0.2	U	NS	NS
FIELD PARAMETERS									
pH (SU)	4.25	5.95	7.70	10.48	9.47	9.33	6.72	6.48	5.77
Temperature (°C)	14.54	14.73	15.57	15.95	16.99	17.09	17.01	17.78	17.85
Dissolved Oxygen (DO; mg/L)	31.84	1.57	0.85	0.63	0.48	1.99	4.44	4.42	4.41
Redox Potential (ORP; mV)	434.0	-59.9	-259.5	-394.5	-291.1	-384.5	-57.2	7.7	49.9
Conductivity (µS/cm)	638	338	289	349	301	296	3376	3799	459
Depth to Water (ft-btoc)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table D.34. CW-2: Analytical and Field Data Results

Sample ID	NJ Higher of	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2		
Lab Sample No.	POLs and	8543-18	8560-2	8561-16	8573-1	8576-4	8577-4	8581-1				8647-2	8665-16	8678-7	
Sampling Date	GW Quality	11/16/2011	12/12/2011	12/13/2011	12/28/2011	1/5/2012	1/9/2012	1/12/2012	1/16/2012	1/19/2012	2/7/2012	3/26/2012	4/18/2012	5/2/2012	
Time (days)		-26	0	1	16	24	28	31	35	38	57	105	128	142	
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
dichlorodifluoromethane	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
vinyl chloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromomethane	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloroethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trichlorofluoromethane	2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
methylene chloride	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trans-1,2-dichloroethylene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloroethane	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2,2-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
cis-1,2-dichloroethylene	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromochloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chloroform	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,1-trichloroethane	30	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
carbon tetrachloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1-dichloropropene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
benzene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichloroethane	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichloropropane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,1,2-tetrachloroethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromodichloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
cis-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
toluene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
trans-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2-trichloroethane	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tetrachloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dibromomethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
chlorobenzene	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,1,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
ethylbenzene	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
xylenes (m/p)	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
o-xylene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
styrene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromoform	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
isopropyl benzene (cumene)	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
bromobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,3-trichloropropane	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
n-propyl benzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3,5-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tert-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,4-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
sec-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,3-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-isopropyltoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,4-dichlorobenzene	75	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
n-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-dibromo-3-chloropropane	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,4-trichlorobenzene	9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
hexachlorobutadiene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
naphthalene	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
1,2,3-trichlorobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Methyl tertiary butyl ether	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Acetone	6000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
carbon disulfide	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-butanone (MEK)	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
tetrahydrofuran (THF)	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
4-methyl-2-pentanone (MIBK)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-hexanone		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
2-chloroethyl vinyl ether		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Methane	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Ethane	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Ethene	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Hydrogen	NA	NS	0.0033	J	0.0034	J	2.02	130	434	335	NS	NS	441	1190	793
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron	300	NS	147	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	299	
Manganese	50	NS	134	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	50.3	
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Iron		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3420	
Manganese		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	108	
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Calcium		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	12600	
Magnesium		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	18600	
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Alkalinity as CaCO3	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.0	
Sulfide	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.08	
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Fluoride	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Chloride	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.37	
Nitrite as N	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2	
Sulfate as SO4	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	31.9	
Bromide	NA	1.39	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.06	
Nitrate as N	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2	
O-Phosphate as P	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.2	
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Lactic Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Acetic Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Propionic Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Formic Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Butyric Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Pyruvic Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Valeric Acid	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
FIELD PARAMETERS															
pH (SU)	NA	NS	5.51	5.38	5.49	6.14	8.37	10.12	10.55	10.02	10.81	11.08	11.35	10.21	
Temperature (°C)	NA	NS	15.19	15.41	13.05	14.1	14.3	14.13	13.79	13.52	13.54	12.62	13.19	13.54	
Dissolved Oxygen (DO; mg/L)	NA	NS	0.08	0.14	0.25	0.13	0.10	0.21	0.62	0.75	-0.34	0.58	0.51	0.55	
Redox Potential (ORP; mV)	NA	NS	242.5	205.4	188.4	-339.0	-438.6	-499.6	-419.0	-514.6	-510.1	-421.9	-370.0	-461.5	
Conductivity (µS/cm)	NA	NS	302	455	275	299.9	303.2	288	323	295	399	609	818	761	
Depth to Water (ft-bloc)	NA	NS	7.35	7.37	6.85	7.02	7.25	7.25	NS	NS	NS	8.32	7.65	7.40	

Table D.34. CW-2: Analytical and Field Data Results

[illegible]

Table D.34. CW-2: Analytical and Field Data Results

Sample ID	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2	CW-2
Lab Sample No.	8818-1	8837-4	8839-4	8840-1	8850-1	8852-1	8869-1	8876-1	8883-7	8929-1	8954-1	8977-2
Sampling Date	9/12/2012	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012	12/18/2012	3/14/2013	4/24/2013	6/11/2013
Time (days)	275	294	295	296	298	316	339	358	372	458	499	547
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
chloromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
vinyl chloride	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
bromomethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
chloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
methylene chloride	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	67.3 D	NS	NS	95.8 D	61.0 D	25.8 D	NS
bromochloromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
chloroform	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
carbon tetrachloride	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
benzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
trichloroethylene	NS	NS	NS	NS	NS	2900 D	NS	NS	2940 D	2180 D	349 D	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
dibromomethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
bromodichloromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
toluene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
tetrachloroethylene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
dibromochloromethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
chlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
ethylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
xlenes (m/p)	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
o-xylene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
styrene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
bromoform	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
bromobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
n-propyl benzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
2-chlorotoluene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
4-chlorotoluene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
tert-butylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
sec-butylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
n-butylbenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
naphthalene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
Acetone	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
carbon disulfide	NS	NS	NS	NS	NS	42.0 U	NS	NS	42.0 U	25.0 U	25.0 U	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
2-hexanone	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	84.0 U	NS	NS	84.0 U	50.0 U	50.0 U	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	NS	248	NS	NS	254	83.8	2.22	NS
Ethane	NS	NS	NS	NS	NS	2.7	NS	NS	1.76 J	1.15 J	4.0 U	NS
Ethene	NS	NS	NS	NS	NS	7.8	NS	NS	6.67	3.74 J	5.0 U	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	613	62.2	58.9	60.9	17.7	22.4	2.15	74.0	67.3	146	356	99.9
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	8840	NS	NS	6660	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	55.5	NS	NS	73.2	NS	NS	NS
Arsenic	NS	NS	NS	NS	NS	2.5 U	NS	NS	NS	NS	NS	NS
METALS (TOTAL)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	NS	NS	NS	NS	9740	NS	NS	NS
Manganese	NS	NS	NS	NS	NS	NS	NS	NS	72.8	NS	NS	NS
CATIONS	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Calcium	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Magnesium	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GROUNDWATER CHEMISTRY	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Alkalinity as CaCO ₃	NS	NS	NS	NS	NS	0.20 J	NS	NS	NS	NS	NS	NS
Sulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	0.07 J	1.0 U	1.0 U	1.0 U	1.0 U	0.2 J	NS	0.18 J	0.2 U	NS	NS	NS
Chloride	9.14	17.2	17.7	16.4	16.9	17.0	NS	19.5	23.3	NS	NS	NS
Nitrite as N	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS	NS	NS
Sulfate as SO ₄	38.0 E	77.2 D	89.7	87.7 D	91.9 D	56.7 E	NS	55.9 E	27.3 E	NS	NS	NS
Bromide	0.75	1.45	3.22	14.4	30.4	8.13	NS	7.88	5.11	NS	NS	NS
Nitrate as N	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS	NS	NS
O-Phosphate as P	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	NS	0.2 U	0.2 U	NS	NS	NS
VOLATILE FATTY ACIDS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactic Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Acetic Acid	0.81 J	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Propionic Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Formic Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Butyric Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Pyruvic Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
Valeric Acid	1.0 U	NS	NS	NS	NS	NS	NS	NS	1.0 U	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	5.39	4.74	4.43	4.22	4.53	4.76	5.06	4.66	4.74	5.51	12.30	5.20
Temperature (°C)	19.22	18.32	17.90	17.69	17.92	15.92	12.96	15.28	15.27	11.32	12.58	17.19
Dissolved Oxygen (DO; mg/L)	3.47	0.64	4.67	1.19	0.45	0.24	0.66	0.16	0.45	0.11	0.27	0.84
Redox Potential (ORP; mV)	-19.5	49.0	88.6</									

Table D.35. CW-3: Analytical and Field Parameter Results

Sample ID	NJ Higher of	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3
Lab Sample No.	POLs and	8543-19	8561-17	8573-7	8576-6	8577-6	8581-3				8647-3	8665-17
Sampling Date	GW Quality	11/16/2011	12/12/2011	12/28/2011	1/5/2012	1/9/2012	1/12/2012	1/16/2012	1/19/2012	2/7/2012	3/26/2012	4/18/2012
Time (days)		-26	0	16	24	28	31	35	38	57	105	128
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis 1,2- dichloroethylene	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m/p)	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	6000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	NS	0.0036	J	27.8	147	579	298	NS	NS	339	768
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Chloride	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrite as N	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate as SO ₄	250	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bromide	NA	6.22	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrate as N	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
O-Phosphate as P	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	NS	5.01	NS	6.56	10.42	10.03	10.48	10.36	10.38	11.76	11.52
Temperature (°C)	NA	NS	15.22	NS	13.1	13.7	13.22	13.40	13.72	13.49	12.73	13.56
Dissolved Oxygen (DO; mg/L)	NA	NS	0.01	NS	0.26	0.13	0.19	0.62	0.21	0.65	0.39	0.78
Redox Potential (ORP; mV)	NA	NS	253.3	NS	-353.4	-472.5	-430.7	-410.7	-519.7	-466.7	-416.0	-373.2
Conductivity (µS/cm)	NA	NS	244	NS	270.5	303.1	328	301	295	369	1416	1130
Depth to Water (ft-btoc)	NA	NS	6.70	NS	6.60	6.74	6.54	NS	NS	NS	7.39	7.50

Table D.35. CW-3: Analytical and Field Parameter Results

Sample ID	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3	CW-3
Lab Sample No.						8713-29	8717-32		
Sampling Date	5/9/2012	5/11/2012	5/21/2012	5/30/2012	6/7/2012	6/11/2012	6/13/2012	6/15/2012	6/19/2012
Time (days)	149	151	161	170	178	182	184	186	190
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
xlenes (m/p)	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Chloride	NS	NS	NS	NS	NS	3.30	NS	NS	NS
Nitrite as N	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	NS	NS	NS	NS	NS	25.1 E	NS	NS	NS
Bromide	NS	NS	NS	NS	NS	0.38	1420	654	21.9
Nitrate as N	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
FIELD PARAMETERS									
pH (SU)	5.86	5.86	6.85	9.09	8.64	10.25	6.59	6.60	6.81
Temperature (°C)	14.28	14.57	13.35	16.02	16.81	16.91	17.73	16.97	17.34
Dissolved Oxygen (DO; mg/L)	19.82	1.13	0.35	0.42	0.49	0.68	1.39	0.65	2.74
Redox Potential (ORP; mV)	147.3	52.2	-224.3	-365.4	-229.3	-354.4	-8.9	30.5	45.6
Conductivity (µS/cm)	611	440	318	209	368	550	2347	1370	543
Depth to Water (ft-btoc)	6.50	NS	NS	NS	NS	7.77	7.42	7.32	NS

Table D.36. AW-1: Analytical and Field Parameter Results

Sample ID	NJ Higher of	AW-1	AW-1	AW-1	AW-1	AW-1
Lab Sample No.	PQLs and	8561-12				
Sampling Date	GW Quality	12/13/2011	1/5/2012	1/9/2012	2/7/2012	5/9/2012
Time (days)		1	24	28	57	149
Matrix	2005 Criteria	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	NS	NS	NS	NS	NS
chloromethane		NS	NS	NS	NS	NS
vinyl chloride	1	NS	NS	NS	NS	NS
bromomethane	10	NS	NS	NS	NS	NS
chloroethane		NS	NS	NS	NS	NS
trichlorofluoromethane	2000	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	NS	NS	NS	NS	NS
methylene chloride	3	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	NS	NS	NS	NS	NS
1,1-dichloroethane	50	NS	NS	NS	NS	NS
2,2-dichloropropane		NS	NS	NS	NS	NS
cis-1,2-dichloroethylene	70	NS	NS	NS	NS	NS
bromochloromethane		NS	NS	NS	NS	NS
chloroform	70	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	NS	NS	NS	NS	NS
carbon tetrachloride	1	NS	NS	NS	NS	NS
1,1-dichloropropene		NS	NS	NS	NS	NS
benzene	1	NS	NS	NS	NS	NS
1,2-dichloroethane	2	NS	NS	NS	NS	NS
trichloroethylene	1	NS	NS	NS	NS	NS
1,2-dichloropropane	1	NS	NS	NS	NS	NS
dibromomethane		NS	NS	NS	NS	NS
bromodichloromethane	1	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	NS	NS	NS	NS	NS
toluene	600	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	NS	NS	NS	NS	NS
tetrachloroethylene	1	NS	NS	NS	NS	NS
1,3-dichloropropane		NS	NS	NS	NS	NS
dibromochloromethane	1	NS	NS	NS	NS	NS
1,2-dibromoethane		NS	NS	NS	NS	NS
chlorobenzene	50	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	NS	NS	NS	NS	NS
ethylbenzene	700	NS	NS	NS	NS	NS
xylene (m/p)	1000	NS	NS	NS	NS	NS
o-xylene		NS	NS	NS	NS	NS
styrene	100	NS	NS	NS	NS	NS
bromoform	4	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	NS	NS	NS	NS	NS
bromobenzene		NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	NS	NS	NS	NS	NS
n-propyl benzene		NS	NS	NS	NS	NS
2-chlorotoluene		NS	NS	NS	NS	NS
4-chlorotoluene		NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		NS	NS	NS	NS	NS
tert-butylbenzene		NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		NS	NS	NS	NS	NS
sec-butylbenzene		NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	NS	NS	NS	NS	NS
4-isopropyltoluene		NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	NS	NS	NS	NS	NS
n-butylbenzene		NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	NS	NS	NS	NS	NS
hexachlorobutadiene	1	NS	NS	NS	NS	NS
naphthalene	300	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	NS	NS	NS	NS	NS
Acetone	6000	NS	NS	NS	NS	NS
carbon disulfide	700	NS	NS	NS	NS	NS
2-butanone (MEK)	300	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		NS	NS	NS	NS	NS
2-hexanone		NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.0033	J	NS	NS	NS
FIELD PARAMETERS						
pH (SU)	NA	4.05	3.41	2.87	3.04	5.69
Temperature (°C)	NA	15.79	15.10	14.8	14.18	14.20
Dissolved Oxygen (DO; mg/L)	NA	0.19	1.27	6.88	2.93	0.98
Redox Potential (ORP; mV)	NA	141.9	272.8	395.5	288.9	-156.1
Conductivity (µS/cm)	NA	439	308.8	415.5	487	229
Depth to Water (ft-btoc)	NA	7.02	NS	NS	NS	8.25

Table D.37. AW-2: Analytical and Field Parameter Results

Sample ID	NJ Higher of	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2
Lab Sample No.	PQLs and	8560-1	8561-13	8573-2								
Sampling Date	GW Quality	12/12/2011	12/13/2011	12/28/2011	1/5/2012	1/9/2012	2/7/2012	5/9/2012	5/30/2012	8/16/2012	8/31/2012	9/12/2012
Time		0	1	16	24	28	57	149	170	248	263	275
Matrix	2005 Criteria	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
vinyl chloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromomethane	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichlorofluoromethane	2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
methylene chloride	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,2-dichloroethylene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloroethane	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,2-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis 1,2- dichloroethylene	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromochloromethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chloroform	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1-trichloroethane	30	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon tetrachloride	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1-dichloropropene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
benzene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloroethane	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trichloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichloropropane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromomethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromodichloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
cis-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
toluene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
trans-1,3-dichloropropene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2-trichloroethane	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrachloroethylene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichloropropane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
dibromochloromethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromoethane		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
chlorobenzene	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,1,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ethylbenzene	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
xylenes (m/p)	1000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
o-xylene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
styrene	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromoform	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
isopropyl benzene (cumene)	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
bromobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,1,2,2-tetrachloroethane	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichloropropane	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-propyl benzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-chlorotoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3,5-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tert-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trimethylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
sec-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,3-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-isopropyltoluene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,4-dichlorobenzene	75	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dichlorobenzene	600	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
n-butylbenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2-dibromo-3-chloropropane	0.02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,4-trichlorobenzene	9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
hexachlorobutadiene	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
naphthalene	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1,2,3-trichlorobenzene		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Methyl tertiary butyl ether	70	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Acetone	6000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
carbon disulfide	700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-butanone (MEK)	300	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
tetrahydrofuran (THF)	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4-methyl-2-pentanone (MIBK)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-hexanone		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2-chloroethyl vinyl ether		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethane	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethene	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	NA	0.0018 J	0.0041	0.0080 U	NS	NS	NS	NS	NS	NS	NS	NS
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	300	664 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	50	53 D	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	250	NS	NS	NS	NS	NS	NS	NS	13.1	NS	NS	NS
Nitrite as N	1	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
Sulfate as SO ₄	250	NS	NS	NS	NS	NS	NS	NS	95.9 E	NS	NS	NS
Bromide	NA	NS	NS	NS	NS	NS	NS	NS	1.74	NS	NS	NS
Nitrate as N	10	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
O-Phosphate as P	NA	NS	NS	NS	NS	NS	NS	NS	0.2 U	NS	NS	NS
FIELD PARAMETERS												
pH (SU)	NA	4.61	4.39	3.80	2.90	2.71	2.69	9.36	2.44	3.85	3.99	4.06
Temperature (°C)	NA	15.03	15.62	14.90	14.6	14.4	13.91	14.04	16.22	17.63	18.04	18.16
Dissolved Oxygen (DO; mg/L)	NA	0.21	0.07	0.51	8.05	18.64	1.99	0.94	13.46	10.38	0.49	3.43
Redox Potential (ORP; mV)	NA	283.6	268.3	397.6	519.5	492.5	378.8	-311.0	465.3	-12.5	160.4	102.5
Conductivity (µS/cm)	NA	276	409	288	490.6	760	1036	339	649	272	278	192
Depth to Water (ft-bloc)	NA	6.80	6.91	6.65	NS	NS	NS	7.60	NS	7.86	7.97	7.78

Table D.37. AW-2: Analytical and Field Parameter Results

Sample ID	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2	AW-2
Lab Sample No.	8837-11	8839-11	8840-11	8850-11	8852-2	8869-11	8876-11
Sampling Date	10/1/2012	10/2/2012	10/3/2012	10/5/2012	10/23/2012	11/15/2012	12/4/2012
Time	294	295	296	298	316	339	358
Matrix	Water	Water	Water	Water	Water	Water	Water
VOCS (GC/MS)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
dichlorodifluoromethane	NS	NS	NS	NS	42.0 U	NS	NS
chloromethane	NS	NS	NS	NS	42.0 U	NS	NS
vinyl chloride	NS	NS	NS	NS	42.0 U	NS	NS
bromomethane	NS	NS	NS	NS	42.0 U	NS	NS
chloroethane	NS	NS	NS	NS	42.0 U	NS	NS
trichlorofluoromethane	NS	NS	NS	NS	42.0 U	NS	NS
1,1-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS
methylene chloride	NS	NS	NS	NS	42.0 U	NS	NS
trans-1,2-dichloroethylene	NS	NS	NS	NS	42.0 U	NS	NS
1,1-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS
2,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS
cis 1,2- dichloroethylene	NS	NS	NS	NS	56.7 D	NS	NS
bromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS
chloroform	NS	NS	NS	NS	42.0 U	NS	NS
1,1,1-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS
carbon tetrachloride	NS	NS	NS	NS	42.0 U	NS	NS
1,1-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS
benzene	NS	NS	NS	NS	42.0 U	NS	NS
1,2-dichloroethane	NS	NS	NS	NS	42.0 U	NS	NS
trichloroethylene	NS	NS	NS	NS	3110 D	NS	NS
1,2-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS
dibromomethane	NS	NS	NS	NS	42.0 U	NS	NS
bromodichloromethane	NS	NS	NS	NS	42.0 U	NS	NS
cis-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS
toluene	NS	NS	NS	NS	42.0 U	NS	NS
trans-1,3-dichloropropene	NS	NS	NS	NS	42.0 U	NS	NS
1,1,2-trichloroethane	NS	NS	NS	NS	42.0 U	NS	NS
tetrachloroethylene	NS	NS	NS	NS	42.0 U	NS	NS
1,3-dichloropropane	NS	NS	NS	NS	42.0 U	NS	NS
dibromochloromethane	NS	NS	NS	NS	42.0 U	NS	NS
1,2-dibromoethane	NS	NS	NS	NS	42.0 U	NS	NS
chlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,1,1,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS
ethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
xylenes (m/p)	NS	NS	NS	NS	42.0 U	NS	NS
o-xylene	NS	NS	NS	NS	42.0 U	NS	NS
styrene	NS	NS	NS	NS	42.0 U	NS	NS
bromoform	NS	NS	NS	NS	42.0 U	NS	NS
isopropyl benzene (cumene)	NS	NS	NS	NS	42.0 U	NS	NS
bromobenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,1,2,2-tetrachloroethane	NS	NS	NS	NS	42.0 U	NS	NS
1,2,3-trichloropropane	NS	NS	NS	NS	42.0 U	NS	NS
n-propyl benzene	NS	NS	NS	NS	42.0 U	NS	NS
2-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS
4-chlorotoluene	NS	NS	NS	NS	42.0 U	NS	NS
1,3,5-trimethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
tert-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,2,4-trimethylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
sec-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,3-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
4-isopropyltoluene	NS	NS	NS	NS	42.0 U	NS	NS
1,4-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,2-dichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
n-butylbenzene	NS	NS	NS	NS	42.0 U	NS	NS
1,2-dibromo-3-chloropropane	NS	NS	NS	NS	42.0 U	NS	NS
1,2,4-trichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
hexachlorobutadiene	NS	NS	NS	NS	42.0 U	NS	NS
naphthalene	NS	NS	NS	NS	42.0 U	NS	NS
1,2,3-trichlorobenzene	NS	NS	NS	NS	42.0 U	NS	NS
Methyl tertiary butyl ether	NS	NS	NS	NS	42.0 U	NS	NS
Acetone	NS	NS	NS	NS	84.0 U	NS	NS
carbon disulfide	NS	NS	NS	NS	42.0 U	NS	NS
2-butanone (MEK)	NS	NS	NS	NS	84.0 U	NS	NS
tetrahydrofuran (THF)	NS	NS	NS	NS	84.0 U	NS	NS
4-methyl-2-pentanone (MIBK)	NS	NS	NS	NS	84.0 U	NS	NS
2-hexanone	NS	NS	NS	NS	84.0 U	NS	NS
2-chloroethyl vinyl ether	NS	NS	NS	NS	84.0 U	NS	NS
REDUCED GASES (GC)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	NS	NS	NS	NS	124	NS	NS
Ethane	NS	NS	NS	NS	0.0 U	NS	NS
Ethene	NS	NS	NS	NS	1.1 J	NS	NS
OTHER GASES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Hydrogen	0.009 U	0.0033 J	0.0036 J	0.0113	0.0136	0.0066 J	0.0039 J
METALS (DISSOLVED)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Iron	NS	NS	NS	NS	3480	NS	NS
Manganese	NS	NS	NS	NS	49	NS	NS
Arsenic	NS	NS	NS	NS	2.5 U	NS	NS
ANIONS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Fluoride	1.0 U	1.0 U	0.2 U	0.2 U	0.13 J	NS	0.11 J
Chloride	27.0	28.7	21.2	23.2	16.5	NS	21.9
Nitrite as N	1.0 U	1.0 U	0.2 U	0.2 U	0.2 U	NS	0.2 U
Sulfate as SO ₄	106	97.9	94.5	85.7	69.0 E	NS	67.9 E
Bromide	0.67 J	1.05	21.4	61.6	8.71	NS	7.7
Nitrate as N	1.0 U	1.0 U	0.2 U	0.2 U	0.2 U	NS	0.2 U
O-Phosphate as P	1.0 U	1.0 U	0.2 U	0.2 U	0.2 U	NS	0.2 U
FIELD PARAMETERS							
pH (SU)	3.77	3.85	3.82	3.86	4.19	4.26	4.01
Temperature (°C)	18.25	17.63	17.55	17.91	17.28	13.90	16.67
Dissolved Oxygen (DO; mg/L)	3.32	0.37	0.29	0.34	0.26	0.44	0.27
Redox Potential (ORP; mV)	93.5	100.1	88.4	78.6	43.7	115	49.0
Conductivity (µS/cm)	272	282	269	302	251	162	272
Depth to Water (ft-bloc)	8.10	8.60	8.2	6.94	8.26	7.91	8.60

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**APPENDIX E SEPTEMBER 2016 BI-MONTHLY PROJECT STATUS
REPORT NESDI PROJECT 501**



September 6, 2016

Mr. Wayne C. Hagwood CECM
Hazardous Waste Program Manager
MCB Quantico, GF NREA Branch
3049 Bordelon Street
Quantico, VA 22134-5001
Environmental Compliance Section

**RE: Bi-Monthly Project Status Report: July-August, 2016
 Proton Reduction Technology Demonstration
 NESDI Project 501
 Russell Road Landfill
 Quantico Marine Corps Base, VA**

Dear Mr. Hagwood,

This Bi-Monthly Status Report, prepared by CB&I Federal Services (CB&I), describes the activities conducted during July and August of 2016 as part of our field demonstration of the Proton Reduction Technology (PRT) for degradation of chlorinated volatile organic compounds (cVOCs) in groundwater. The work is being conducted through the Navy's Environmental Sustainability Development to Integration (NESDI) program and is designated NESDI Project 501. The demonstration is being conducted at the southern end of the Russell Road Landfill (RRL), located at Marine Corps Base Quantico in Quantico, Virginia. A site location map is provided in **Figure 1**.

OBJECTIVES

The overall objective of this project is to demonstrate a sustainable (solar-powered) technology for treating cVOCs in low pH, low permeability, and/or continuing contaminant source aquifers. The project involves the operation of a pilot-scale PRT system at the RRL site. Specific objectives for this field demonstration are as follows:

- Evaluate the ability of PRT to increase groundwater pH in a low pH aquifer, and/or maintain groundwater pH at neutral levels (i.e. between approximately 6.0 and 8.0 standard units);
- Evaluate the production and distribution of hydrogen (H₂) and proton consumption within a low permeability aquifer;
- Evaluate the efficacy of PRT, coupled with bioaugmentation with a dechlorinating bacterial culture (e.g., SDC-9), to enhance biodegradation of cVOCs [primarily *cis*-1,2-dichloroethene (*cis*-DCE)]; and,
- Evaluate the performance and efficiency of the PRT electrode design and construction.

Successful demonstration of the technology will provide a viable remedial approach for a number of other Navy and Department of Defense (DoD) sites.



PRT DESCRIPTION

PRT involves the use of electrodes inserted into an aquifer to generate H_2 , which can be used as an electron donor (i.e., energy source) for chlorinated solvent-degrading bacteria (Lohner and Tiehm, 2009; Lohner et al. 2011; Steffan and Sewell, 2011). A generalized schematic of solar powered PRT is provided as **Figure 2**. H_2 is produced by electrolysis and reduction of hydrogen ions (H^+) (i.e., protons) on a cathode. H_2 is an important energy source and electron donor in anaerobic metabolism, including dehalorespiration, which results in dechlorination of chlorinated solvents (He et al. 2003; Maymo-Gatell et al., 1997, 2001). This PRT pilot demonstration will provide direct *in situ* generation of H_2 by electrical reduction of free protons (H^+).

Proton reduction occurs at a potential of approximately -0.5 volts (V) which can be supplied easily with solar-charged batteries. Because protons are the cause of acidity, their reduction at the cathode increases pH. In addition to proton reduction, electrical current can be used to further increase aquifer pH. At an electrical potential of approximately -2 V, water molecules are split into a proton (H^+) and a hydroxide ion (OH^-); the hydroxide ion is a strong base. This process is often referred to as electrolysis or hydrolysis. The produced proton will then be reduced to H_2 , and the OH^- will further increase aquifer pH. In theory, any amount of OH^- can be produced using this process, thereby allowing neutralization of even very low alkalinity groundwaters like those at the Russell Road Landfill.

The electrodes used for PRT are low power (<20 Voltage Direct Current [VDC]), and are supplied by a relatively small photovoltaic system. The systems are capable of sustainable operation for extended periods to allow treatment of continuous contaminant sources. In addition, the polarity of the proton reduction system can be periodically switched (i.e., the anode becomes a cathode) to increase the size of the treatment area, control the production of H_2 (to minimize methane production), and control changes in pH that can occur, if necessary.

DEMONSTRATION WELL LAYOUT

For this demonstration, eight cathodes were placed in a barrier configuration perpendicular to groundwater flow, and spaced approximately 1.5 feet from one another (**Figure 3**). This close spacing is required due to the relatively low permeability and shallow hydraulic gradient of the aquifer. The anodes were installed in a row approximately 12 feet downgradient of the cathodes. The 9 monitoring wells sampled during this demonstration are summarized as follows:

- Cathode wells CW-2 and CW-7: Treatment zone monitoring wells located within two of the cathode boreholes and within the cathode barrier,
- Performance monitoring wells PMW-1 through PMW-3: Treatment zone monitoring wells located immediately downgradient of the cathode barrier,
- Monitoring well MW-15R: Historic monitoring well with a longer and deeper screen interval located near the center of the test plot,
- Anode well AW-1: Monitoring well located within one of the two anode boreholes,
- Performance monitoring well PMW-4: Monitoring well located immediately downgradient of anode well AW-1, and
- Control well TMW-26S: Historic side-gradient well used as a control well for the demonstration.



Data collected from the 8 monitoring wells located throughout the demonstration plot will be compared against data collected from control well TMW-26S to evaluate efficacy of the treatment approach.

PREVIOUS ACTIVITIES

Previous activities associated with the demonstration included site characterization activities as detailed in the Demonstration Work Plan (CB&I, 2015). Following is a summary of site characterization activities performed during April and June of 2015:

- Underground utility clearance and site clearing,
- Collection of continuous soil cores at 14 locations during electrode and well installations,
- Installation of a total of 10 electrodes and electrode wells, including 8 negatively charged cathodes (CW-1 through CW-8) and 2 positively charged anodes (AW-1 and AW-2),
- Installation of 4 performance monitoring wells (PMW-1 through PMW-4),
- Groundwater sample collection at existing monitoring wells MW-15R and TMW-26S, the 4 newly installed performance monitoring wells, and the 10 electrode wells.

Once site characterization activities were completed, CB&I completed the design and procurement of the PRT system components. System installation was conducted in August and September of 2015. Baseline groundwater samples were collected on September 1-2, 2015 from 8 monitoring wells (PMW-1 through PMW-4, CW-2, CW-7, AW-1, and MW-15R) within the demonstration plot and from well TMW-26S (control well located side-gradient of the demonstration plot) prior to system testing. System testing was performed starting September 2, 2015, and system startup occurred on September 17, 2015. Groundwater parameter measurements collected during the first two months of system operation showed that groundwater pH values increased to within the target range (between approximately 6.0 to 8.0 standard units) in most of the wells within (CW-1 through CW-8) and immediately downgradient (PMW-1 through PMW-3) of the cathode barrier.

On December 1, 2015, bioaugmentation with CB&I's SDC-9 dechlorinating culture was performed by injecting the culture into the eight cathode monitoring wells (CW-1 through CW-8). A total of 4 liters of culture (0.5 liters per well) was injected in the target treatment zone. Immediately prior to bioaugmentation injections, approximately 6 gallons of groundwater was pumped from each of the cathode wells, and stored in separate containers. Each bioaugmentation injection took less than 20 minutes to perform. Once injection of the culture was complete, the 6 gallons of groundwater extracted from each of the cathode wells was gravity fed back into the respective wells to further distribute the culture within the surrounding formation.

A pre-bioaugmentation groundwater sampling event was performed on November 17, 2015, and performance groundwater sampling events were performed approximately every six weeks, starting on January 12, 2016. Prior to this reporting period, a total of 5 performance groundwater sampling events have been performed. The 9 monitoring wells that were sampled during the baseline sampling event were also sampled during these events. Results of these sampling events were presented in previous bi-monthly project status reports.



REPORTING PERIOD ACTIVITIES AND RESULTS

During the current reporting period (July 1, 2016 through August 31, 2016), CB&I continued operation and monitoring of the PRT system and conducted Performance Groundwater Sampling Event #6 on August 9, 2016. Groundwater samples were collected via low flow sampling methods using dedicated bladder pumps previously installed in these wells. Samples collected during these events were analyzed for VOCs, reduced gases, anions, volatile fatty acids, and dissolved hydrogen. Field parameters [pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and specific conductivity] were collected in the field during each event using a YSI 8260 (or equivalent) multi-parameter field meter. All groundwater analyses were performed in CB&I's New Jersey-certified analytical laboratory located in Lawrenceville, NJ. The following is a summary of results from Groundwater Sampling Event #6.

Field Parameters and Sulfate

The two key field parameter measurements collected during groundwater sampling include pH and ORP. As previously discussed, the desired pH range for reductive dechlorination is approximately 6.0 to 8.0 standard units (SUs). **Figure 4** provides a graph of pH data collected from the 9 demonstration monitoring wells during groundwater sampling events performed during this demonstration. These data show that operation of the PRT system has successfully increased and is generally maintaining the pH in the desired range within the treatment zone (wells CW-2, CW-7, PMW-1 through PMW-3). As discussed above, monitoring well MW-15R has a deeper and longer screen interval than the other demonstration monitoring wells, and appears to be tapping into groundwater that has noticeably different geochemical properties (very low pH, high ORP and high DO) than the other wells. A modest increase (< 1 standard unit) in groundwater pH has been observed at this well. Anode well AW-1, located in the same borehole as one of the anodes, exhibits a very low pH (<2.0 SUs), as would be expected at an anode. However, pH data collected from performance monitoring well PMW-4 (located 3 feet downgradient of AW-1) indicate no significant change in groundwater pH downgradient of the treatment zone, likely due to the mixing of higher pH groundwater flowing from the cathode barrier with the lower pH groundwater at the anode wells. pH levels in control well TMW-26S are largely unchanged.

The desired ORP level for complete reductive dechlorination is typically less than -100 millivolts (mV). However, the reductive dechlorination process can occur at higher ORP levels (although, typically still in the negative range). **Figure 5** provides a graph of ORP data collected from the 9 demonstration monitoring wells during groundwater sampling events. These data show that operation of the PRT system has successfully decreased groundwater ORP from > +100 mV to between approximately < -50 mV and -150 mV within the treatment zone. ORP levels at monitoring well MW-15R remain largely unchanged, ranging between approximately +300 mV to +400 mV. Anode well AW-1 has exhibited a very high ORP (> +500 mV) since the PRT system was started, as would be expected under the oxidizing condition present at an anode. As with groundwater pH, ORP data collected from performance monitoring well PMW-4 indicate no significant change in groundwater ORP downgradient of the treatment zone due to the mixing of lower ORP groundwater flowing from the cathode barrier with the higher ORP groundwater at the anode wells. ORP levels at control well TMW-26S are largely unchanged.



A decrease in sulfate groundwater concentrations is an indicator that reducing conditions have been established within an aquifer. **Figure 6** provides a graph of sulfate concentration data collected from the 9 demonstration monitoring wells during groundwater sampling events. These data show that operation of the PRT system has successfully reduced sulfate concentrations from greater than 300 mg/L to generally below 100 mg/L in 3 of the 5 treatment zone wells (CW-7, PMW-2, and PMW-3). The other two treatment zone wells (CW-2 and PMW-1) had starting sulfate concentrations below 15 mg/L. Sulfate concentrations at monitoring well MW-15R decreased from 5,800 mg/L to 2,010 mg/L between the baseline sampling event and Performance Sampling Event #6. Anode well AW-1 has shown an increase in sulfate concentrations from 491 mg/L during the baseline event, to 1,190 mg/L during Performance Sampling Event #6, as would be expected under the oxidizing conditions present at an anode. Groundwater data collected from performance monitoring well PMW-4 indicate a moderate decrease in sulfate, with concentrations decreasing from 294 mg/L to 158 mg/L during the demonstration. Sulfate concentrations at control well TMW-26S are largely unchanged.

CVOCs and Ethene

Figures 7 through **9** provide graphs of *cis*-DCE (the primary contaminant of concern), vinyl chloride, and ethene concentration data collected from the 9 demonstration monitoring wells during groundwater sampling events. The data presented in **Figure 7** show decreases in *cis*-DCE ranging from 88 to 99 percent in the 5 treatment zone wells (CW-2, CW-7, and PMW-1 through PMW-3). Decreases in *cis*-DCE of 79 and 76 percent have been observed at wells PMW-4 and MW-15R, respectively. *cis*-DCE concentrations at anode well AW-1 and control well TMW-26S started out significantly lower (12.6 µg/L and 27.8 µg/L, respectively) than the other 7 wells, and are largely unchanged.

Figure 8 shows transient increases in vinyl chloride at several wells, and **Figure 9** shows increasing or transient concentrations of ethene (the innocuous end-product of reductive dechlorination) in the demonstration plot. These data indicate that complete reductive dechlorination is occurring in the treatment area. Groundwater data collected at monitoring well MW-15R show that effective treatment upgradient of this location is positively impacting contaminant concentrations at this well, even with the vastly different geochemical conditions observed at this location.

PMW-4, the most downgradient well, has seen a relatively consistent decrease in *cis*-DCE concentrations (from 305 µg/L to 64.9 µg/L) during the demonstration, and concentrations at this well are currently below the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 70 µg/L. However, the most recent vinyl chloride concentration measured at this well (9.25 µg/L), as well as several other wells, remain above the MCL of 2.0 µg/L. It is expected that the vinyl chloride could further degrade, via either anaerobic or aerobic biological degradation pathways, downgradient of this location. However, there are no monitoring wells downgradient of PMW-4 to show further treatment of this contaminant. Overall, contaminant concentration data show that operation of the PRT system and bioaugmentation have been effective at significantly reducing *cis*-DCE concentrations within the demonstration plot, and continue to treat contaminated groundwater flowing through the plot.

REFERENCES

CB&I. 2015. Demonstration Work Plan, NESDI Project 501, Proton Reduction Technology Demonstration, Russell Road Landfill, Quantico Marine Corps Base, Virginia.



- He, J., K.M. Ritalahti, K. Yang, S.S. Koenigsberg, and F.E. Löffler. 2003. Detoxification of vinyl chloride to ethene coupled to growth of an anaerobic bacterium. *Nature*. 424:62-65.
- Lohner, S.T. and A. Tiehm. 2009. Application of electrolysis to stimulate microbial reductive PCE dechlorination and oxidative VC biodegradation. *Environ. Sci. Technol.* 43:7098-7104.
- Lohner, S.T., D. Becker, K.-M. Mangold, and A. Tiehm. 2011. Sequential reductive and oxidative biodegradation of chloroethenes stimulated in a coupled bioelectro-process. *Environ. Sci. Technol.* 45:6191-6197.
- Maymo-Gatell, X., Y.-t. Chien, J.M. Gossett, and S.H. Zinder. 1997. Isolation of a bacterium that reductively dechlorinates tetrachloroethene to ethene. *Science*. 276:1568-1571.
- Maymo-Gatell, X., I. Nijenhuis, and S.H. Zinder. 2001. Reductive dechlorination of cis-1,2-dichloroethene and vinyl chloride by "Dehalococcoides ethenogenes". *Environ. Sci. Technol.* 35:516-521.
- Steffan, R.J. and G.W. Sewell. 2011. Chapter 11: Advances in Bioremediation of Aquifers. pp. 143-151 in F.F. Quercia and D. Vidojevic (eds.), *Clean Soil and Safe Water*, NATO Science for Peace and Security Series C: Environmental Security. Springer Science + Business Media B.V., ISBN 978-94-007-2239-2.

Do not hesitate to contact me at (609) 895-5380 or david.lippincott@cbifederalservices.com if you have any questions regarding this report.

Sincerely,

CB&I Federal Services, LLC

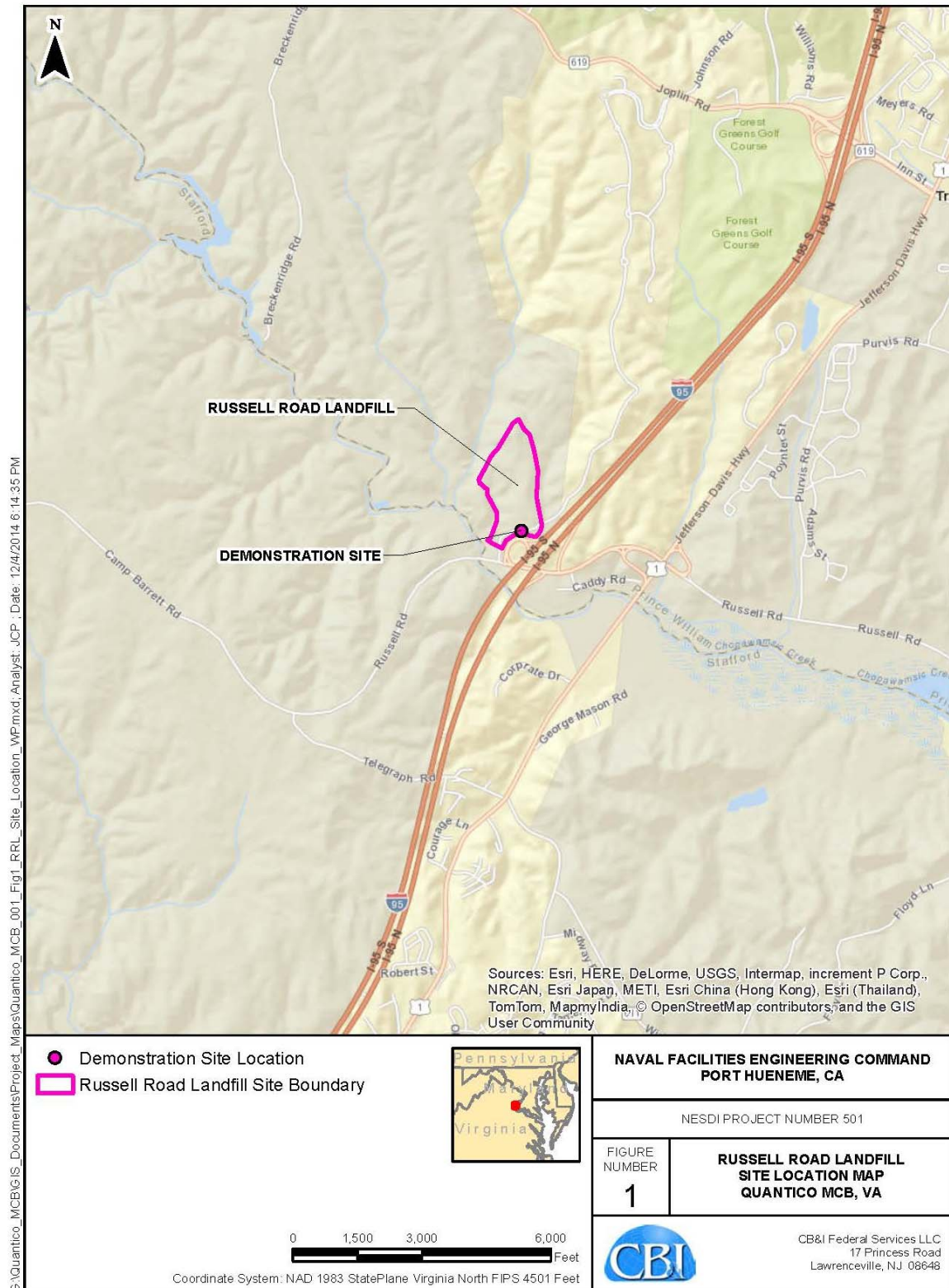
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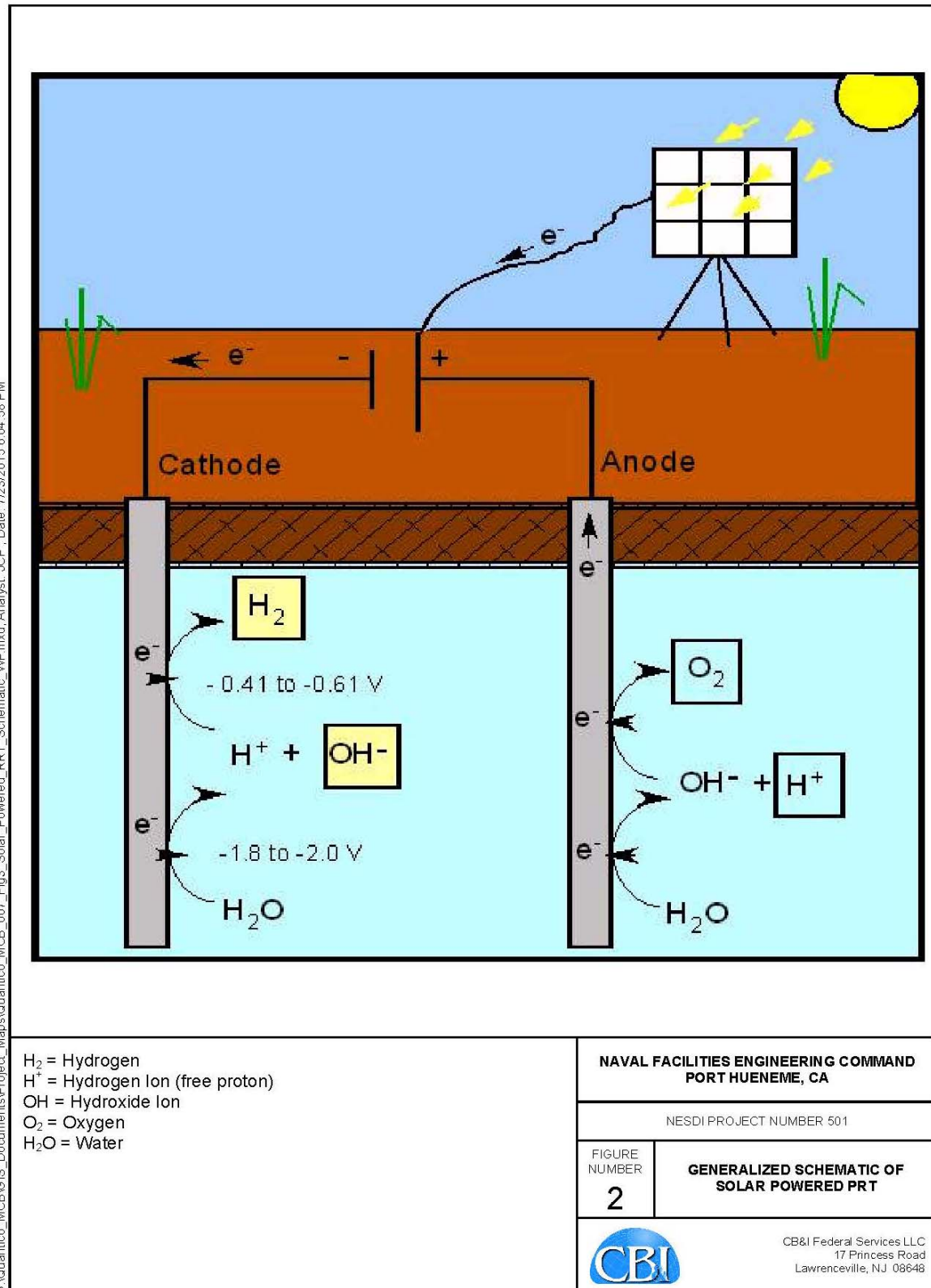
David Lippincott, PG
Project Manager

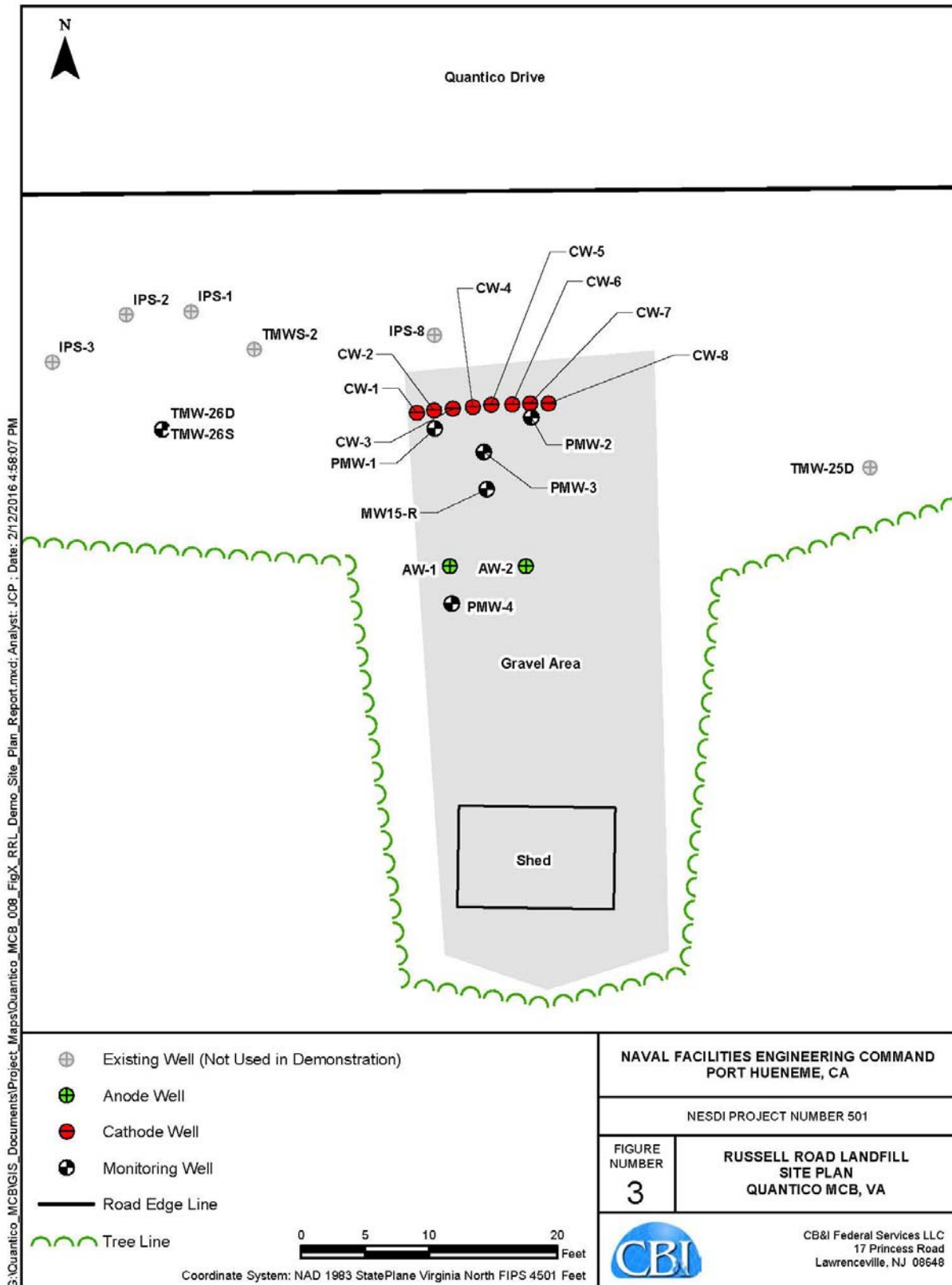
cc: Ms. Nancy Ruiz, NAVFAC, Port Hueneme, CA
Ms. Victoria Waranoski, NAVFAC, Washington DC
Ms. Lyndsay Kelsey, NAVFAC, Washington DC
Mr. Paul Hatzinger, CB&I Federal Services, Lawrenceville, NJ



FIGURES







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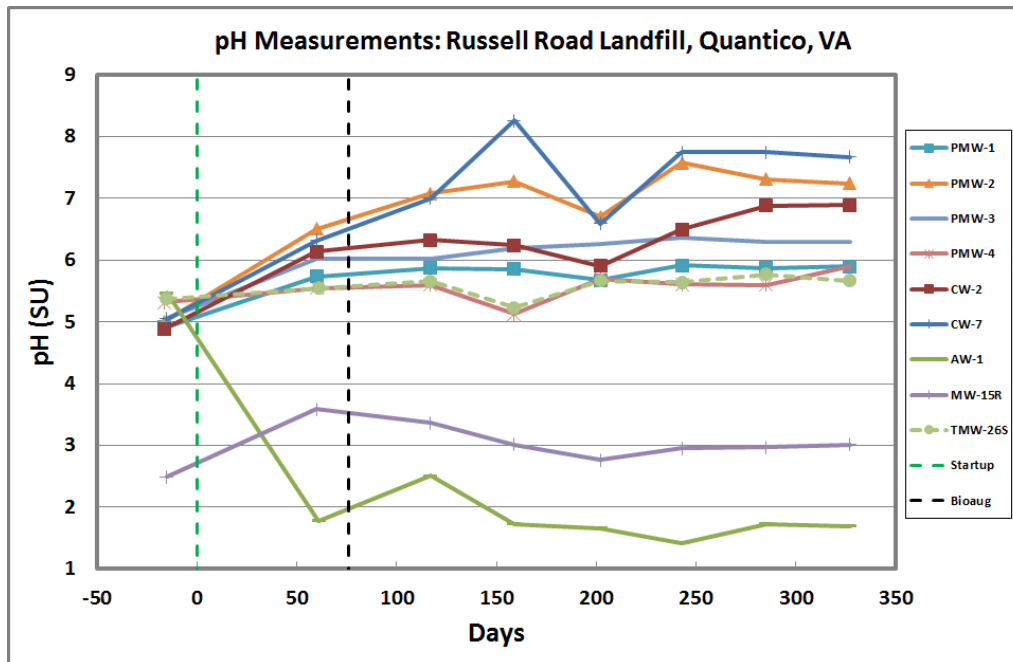


Figure 4. Graph of Monitoring Well pH Measurements

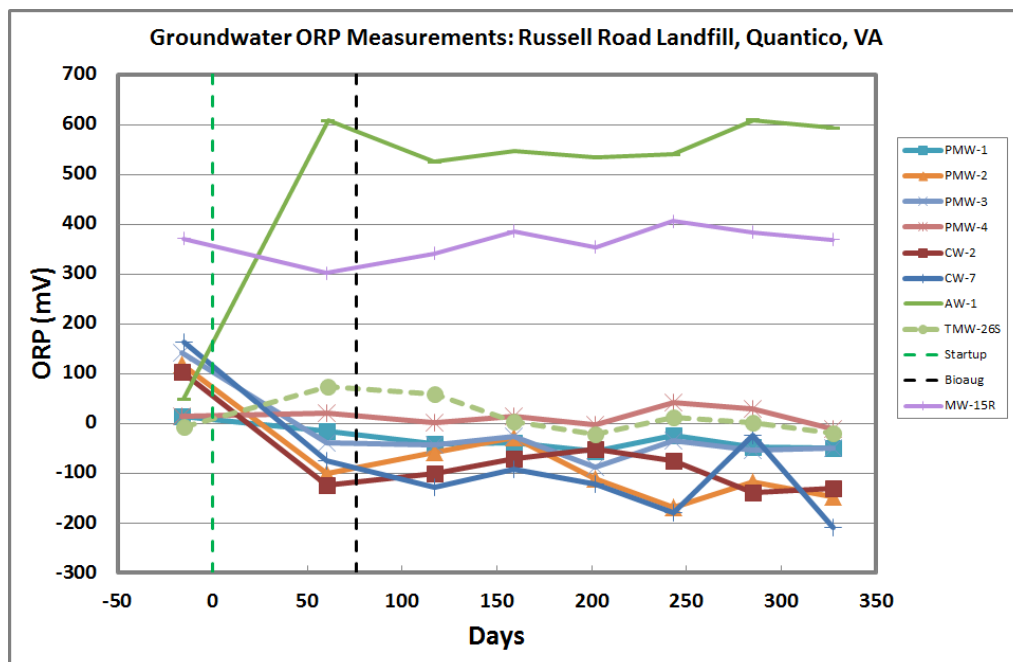


Figure 5. Graph of Monitoring Well ORP Measurements

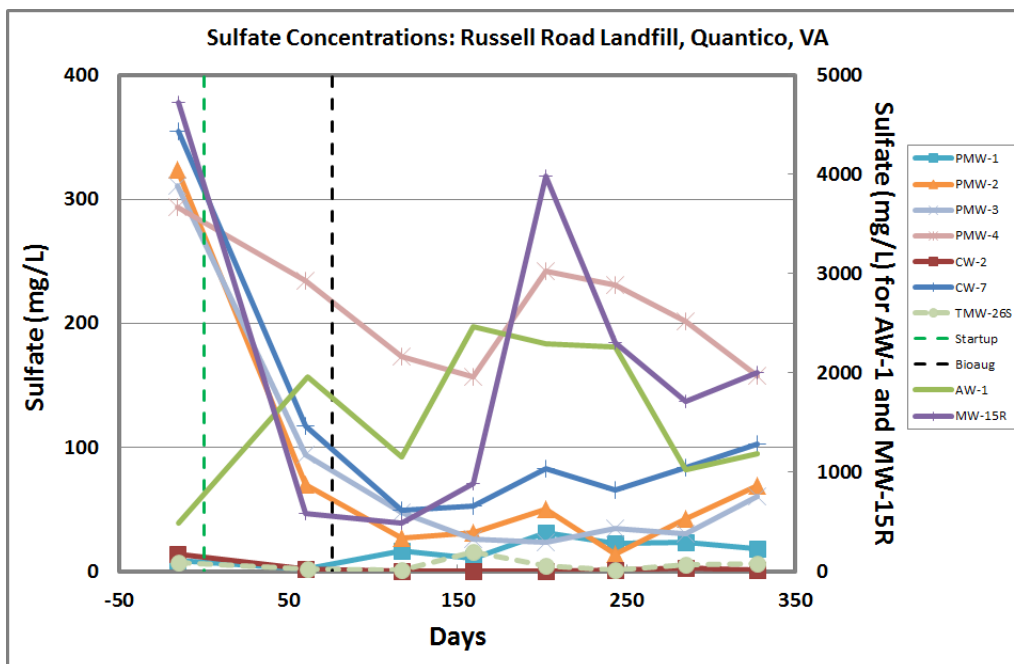


Figure 6. Graph of Monitoring Well Sulfate Concentrations

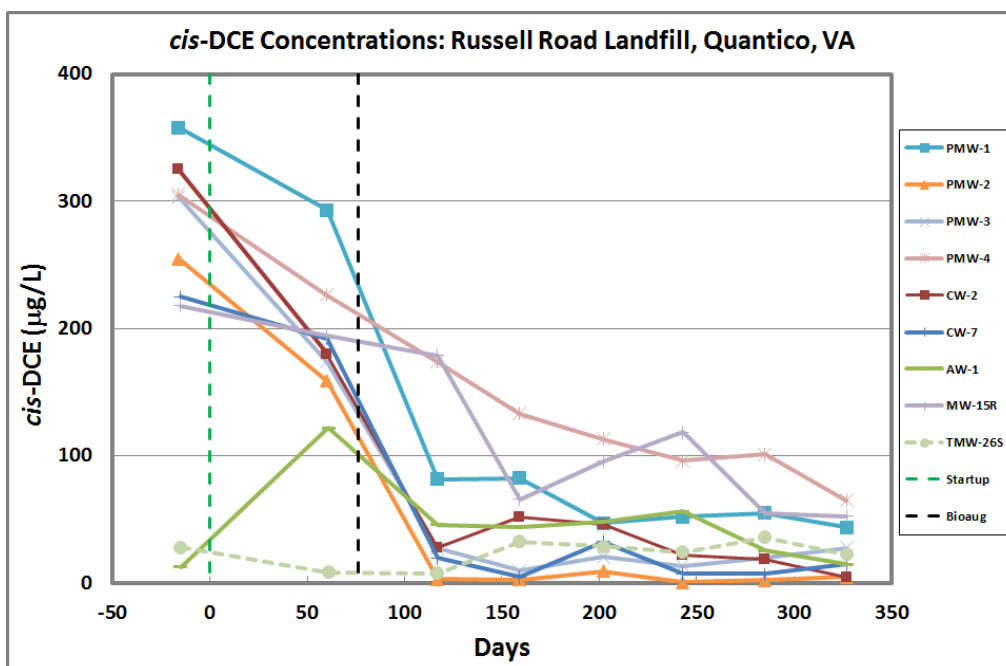


Figure 7. Graph of Monitoring Well *cis*-DCE Concentrations

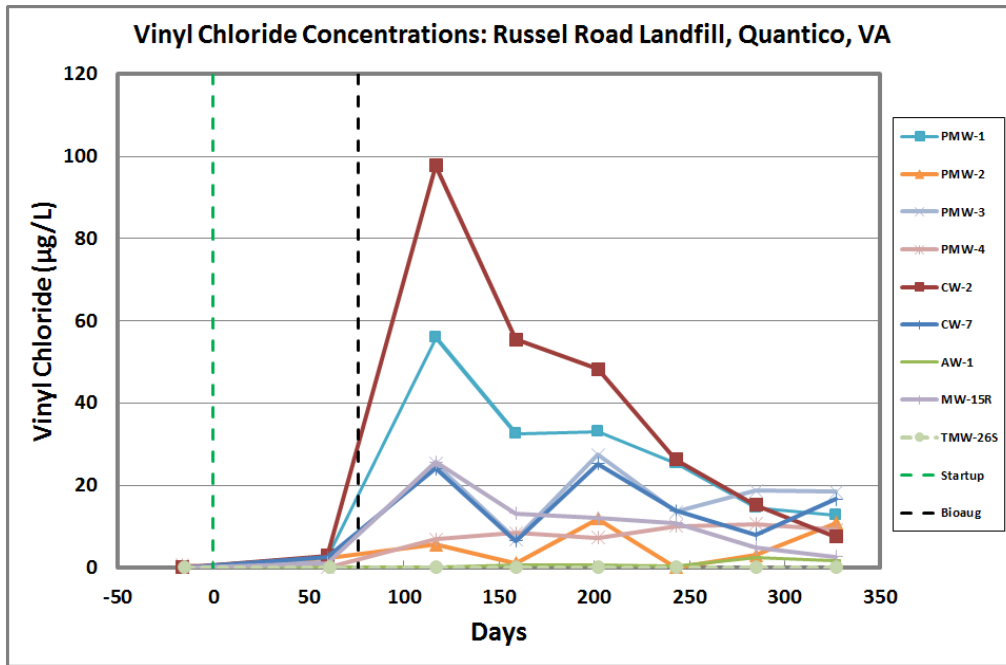


Figure 8. Graph of Monitoring Well Vinyl Chloride Concentrations

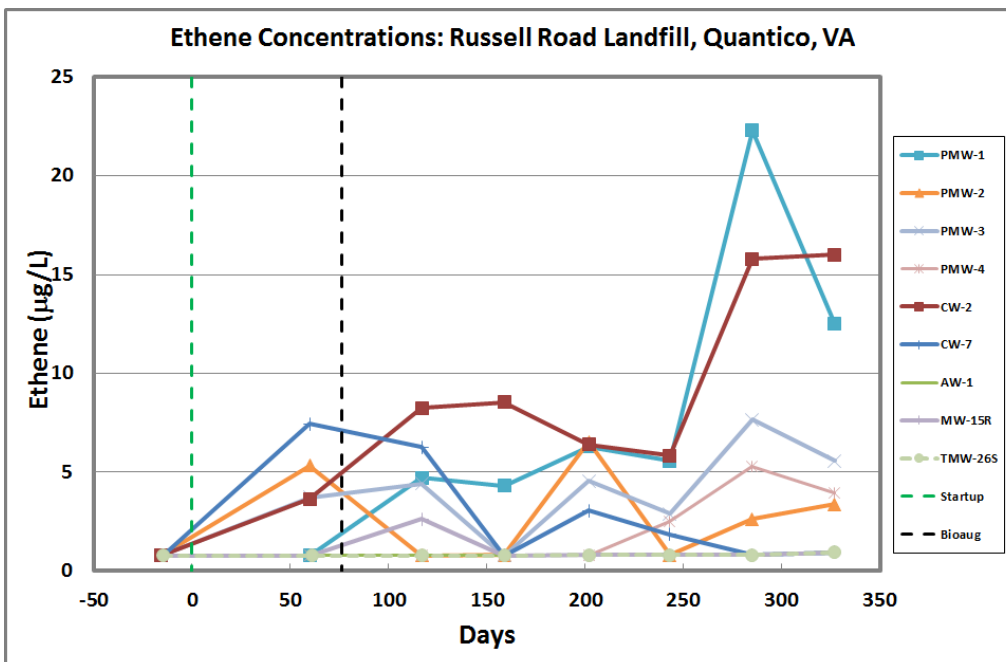


Figure 9. Graph of Monitoring Well Ethene Concentrations